

FINAL

REMEDIAL INVESTIGATION REPORT  
ON THE WASTE DISPOSAL AREA  
SHEREX CHEMICAL COMPANY, INC.  
MAPLETON, ILLINOIS

LPC NO. 1438050006

EPA Region 5 Records Ctr.



383996

Illinois Environmental Protection Agency  
Division of Land Pollution Control  
Springfield, Illinois

Envirodyne Engineers, Inc.  
12161 Lackland Road  
St. Louis, Missouri 63146

May 1988

3059-12000

# TABLE OF CONTENTS

	<u>Page No.</u>
Letter of Transmittal	i
Title Page	ii
Executive Summary	iii
Table of Contents	v
List of Figures	vi
List of Tables	vii

## Section No.

1.0	GENERAL INFORMATION	1-1
1.1	Introduction	1-1
1.2	Project Objective	1-1
1.3	Site Location and Geology	1-2
1.4	Ownership and Prior Use	1-2
1.5	Past Investigative Activities	1-6
2.0	SITE INVESTIGATIONS	2-1
2.1	Introduction	2-1
2.2	Soils Investigation	2-1
2.3	Geophysics Investigation	2-8
2.4	Hydrogeologic Investigation	2-8
2.5	Surface Drainage Sediment Investigation	2-27
3.0	DISCUSSION OF RESULTS	3-1
3.1	Introduction	3-1
3.2	Evaluation Criteria for Analytical Results	3-3
3.3	Soil Sampling Results	3-6
3.4	Groundwater Sampling Results	3-8
3.5	Sediment Sampling Results	3-10
4.0	EXPOSURE ASSESSMENT	4-1
4.1	Introduction	4-1
4.2	Contaminants Found at the Site	4-1
4.3	Environmental Fate and Transport	4-1
4.4	Exposure Evaluation	4-4
4.5	Toxicity Evaluation	4-8
4.6	Risk and Impact Evaluation	4-10
5.0	CONCLUSIONS AND RECOMMENDATIONS	5-1
5.1	Introduction	5-1
5.2	Conclusions	5-1
5.3	Recommendations	5-2
	REFERENCES	REF-1
	BIBLIOGRAPHY	BIB-1
	APPENDICES	
APPENDIX A:	SOIL BORING LOG FORMS	
APPENDIX B:	GEOPHYSICS REPORT	
APPENDIX C:	AQUIFER TEST DATA	
APPENDIX D:	SUPPLY WELL DATA	
APPENDIX E:	ANALYTICAL RESULTS	
APPENDIX F:	USEPA CADMIUM HEALTH ADVISORY DRAFT	

# LIST OF FIGURES

<u>Figure No.</u>		<u>Page No.</u>
1-1	Regional Map	1-3
1-2	Project Site Location	1-4
1-3	Regional Bedrock Cross Section	1-5
1-4	Approximate EP Toxicity Boundary	1-8
2-1	Soil Boring Location	2-3
2-2	Generalized Soil Sampling Methodology	2-5
2-3	Monitor Well Locations	2-9
2-4	Geologic Cross Section A-A'	2-10
2-5	Geologic Cross Section B-B'	2-11
2-6	Geologic Cross Section C-C'	2-12
2-7	Geologic Cross Section Reference Lines	2-13
2-8	Top of Bedrock	2-22
2-9	Fill Trench Delineation	2-23
2-10	Water Levels Measured 10-14-87	2-25
2-11	Sediment Sample Locations	2-28
4-1	Supply Well Locations	4-5

# LIST OF TABLES

<u>Table No.</u>		<u>Page No.</u>
1-1	Chronology of Site Actions	1-7
2-1	Analytical Parameters	2-2
2-2	Soil Boring Sample Collection Summary	2-6
2-3	Well Development Summary	2-15
2-4	Groundwater Monitor Well Field Data	2-17
2-5	Aquifer Test Results	2-19
2-6	Summary of Surdex Survey Measurements	2-20
2-7	Local Supply Well Information	2-26
3-1	Qualitative Summary of RI Analytical Results	3-2
3-2	Minimum Concentrations of Contaminants for Characteristic of EP Toxicity	3-4
3-3	Final MCLGs and Promulgated MCLs for Organic Chemicals and Comparison with Maximum Concentrations Detected in Groundwater Monitor Wells	3-5
3-4	Comparison of Maximum Groundwater Concentrations for Each Metal with Standards	3-7
3-5	Summary of Metal Results in Soils	3-9
4-1	Toxicity Characterization	4-2
4-2	Supply Well Information	4-6

## 1.0 GENERAL INFORMATION

### 1.1 INTRODUCTION

The Illinois Environmental Protection Agency (IEPA) contracted with Envirodyne Engineers, Inc. (EEI) in September 1986 to prepare a Project Outline and Proposal Report (POPR) to investigate the Sherex Waste Disposal Area. This action was initiated in 1981 when Sherex Chemical and Ashland Oil notified the State of a potential hazardous waste site. The site was rated by the USEPA through its Hazardous Ranking System (HRS) in March 1984. In July 1985 the site was placed on the State Remedial Action Priorities List (SRAPL) because of the site's potential contaminant releases to the environment.

Sherex and Ashland cooperated in the development of the project work plans and assisted during the RI process by providing information to the IEPA and EEI. Information provided included boring logs, soil analyses, graphic plots, process diagrams, well data and topographic maps of the site.

This Remedial Investigation (RI) report was prepared to summarize the findings of field activities and provide conclusions and recommendations for further site actions.

### 1.2 PROJECT OBJECTIVE

The objective of the RI was to delineate the extent of contamination within and around the Waste Disposal Area and to generate sufficient information for the development and assessment of remedial alternatives. The major emphasis for the initial phase of the program was to determine the extent of groundwater contamination caused by the disposal of cadmium-laden contaminants. Other important aspects of the program included: defining the horizontal and vertical extent of the previously identified cadmium and any other contaminants present; determining the chemical/physical state and properties of the substances; and assessing the existence/potential for migration of the cadmium or other contaminants of concern.

In order to achieve these project objectives, EEI performed an initial phase of the RI which included a records review, site inspection, preparation of project plans and collection of soils, groundwater and sediment samples for analysis from several locations on the Sherex property. An exposure assessment was also performed in conjunction with the site investigations to determine the fate and transport of contaminants of concern. The field work included collection of soil samples from nine boreholes at various depths; collection of groundwater samples from five locations on two occasions; and collection of four surface sediment samples from the drainage ditches adjacent to the Waste Disposal Area.

The sampling and analysis program was designed to ensure, to the greatest extent practical, detection of contaminants potentially present on-site. Sampling locations were chosen to correspond to areas where evidence of disposal and/or transport of contaminants was most likely present. The analytical program was designed to determine the presence or absence of the most probable pollutants, with a quantification of those found to be present.

### 1.3 SITE LOCATION AND GEOLOGY

#### 1.3.1 Site Location

The Sherex Plant is located just south of Mapleton, Illinois, approximately 20 miles southwest of the City of Peoria. The plant is situated in the eastern half of Section 29 and the western half of Section 28, T7N, R7E (Peoria County). The plant (about 389 acres in size) is bounded by the Illinois River on the south and industrial areas to the east and west. The production facility is located on approximately 40 acres. A regional map depicting the location of the plant site is shown as Figure 1-1.

The study area for this investigation (Waste Disposal Area) consists of less than 10 acres of open grass-covered land situated just east of the production area. A map illustrating the location of the study area in relation to the remainder of the plant is shown as Figure 1-2.

#### 1.3.2 Geology and Physiography

The Sherex production facility is located in the Illinois River valley approximately one mile north of the river. The plant lies on relatively flat ground with elevations ranging from 450 to 460 feet above mean sea level (msl). Bluffs consisting of Bedrock overlain by loess rise to approximately 600 feet msl approximately 2,000 feet north of the site.

The regional geology is dominated by glacial outwash of the Henry Formation. This formation consists of varying sizes of sands and gravels in layers of varied thickness, with occasional thin silt and clay seams distributed throughout the formation. The Henry Formation overlies bedrock of the Carbondale Formation. The Carbondale Formation consists of layered silty shale, limestone, and calcareous siltstone. In the vicinity of the Waste Disposal Area, the bedrock was found to range from approximately 430 to 435 feet msl. Closer to the river, alluvial deposits of clay, fine to coarse sands, and silt are distributed over the Henry Formation. Bedrock was determined to be deeper near the river. A regional cross section of bedrock depth across the site is illustrated in Figure 1-3. Well logs (Figure 4-11) obtained from the Illinois State Water Survey (ISWS) within one half mile of the river indicate shale bedrock at approximately 375 feet msl.

The Henry Formation is a high yielding aquifer for local public water supplies, commercial use and private use. Well logs supplied by the (ISWS) indicated shallow water tables from 6 to 12 feet below ground surface with pumping capacities from 500 to 1,000+ gallons per minute. Based on water level measurements obtained from the on-site monitor wells, local groundwater flows in an east-southeast direction toward the Illinois River. Regionally groundwater flows towards or in the same direction as the river. It is likely the Illinois River receives flow from shallow groundwater.

### 1.4 OWNERSHIP AND PRIOR USE

The Waste Disposal Area is located within the chemical manufacturing facility owned by Sherex Chemical Company. Sherex produces fatty acids, unsaturated alcohols, and fatty nitrogens at the Mapleton plant. The plant uses natural fats and oils to produce most of the manufactured products. Tallow and/or tallow substitutes are the primary raw materials. The primary nitrogen chemicals include industrial chemicals, quaternary softeners, specialty quaternaries, petroleum additives, and mining chemicals.

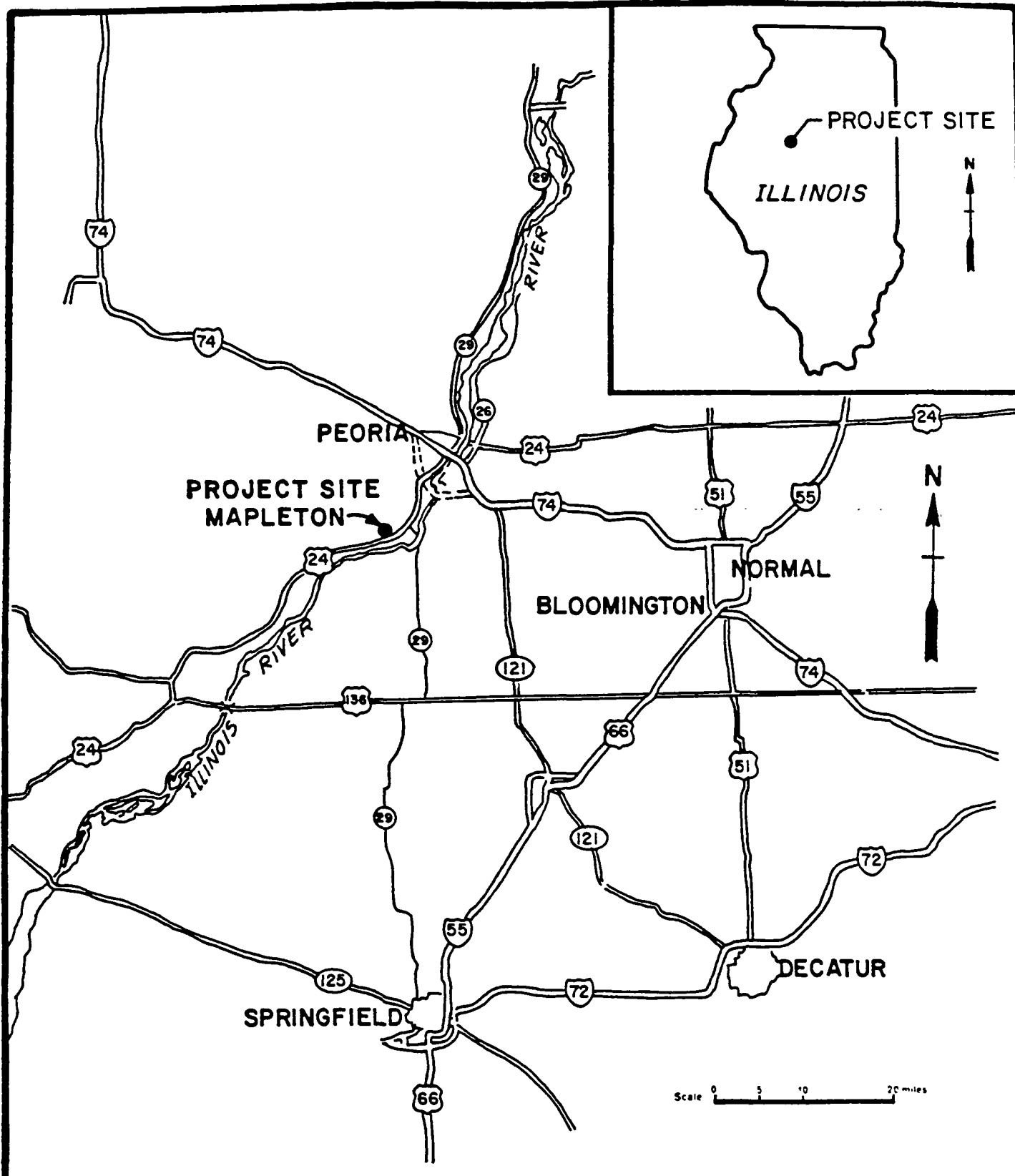


FIGURE I-1

## Regional Map

ENVIRODYNE



ENGINEERS

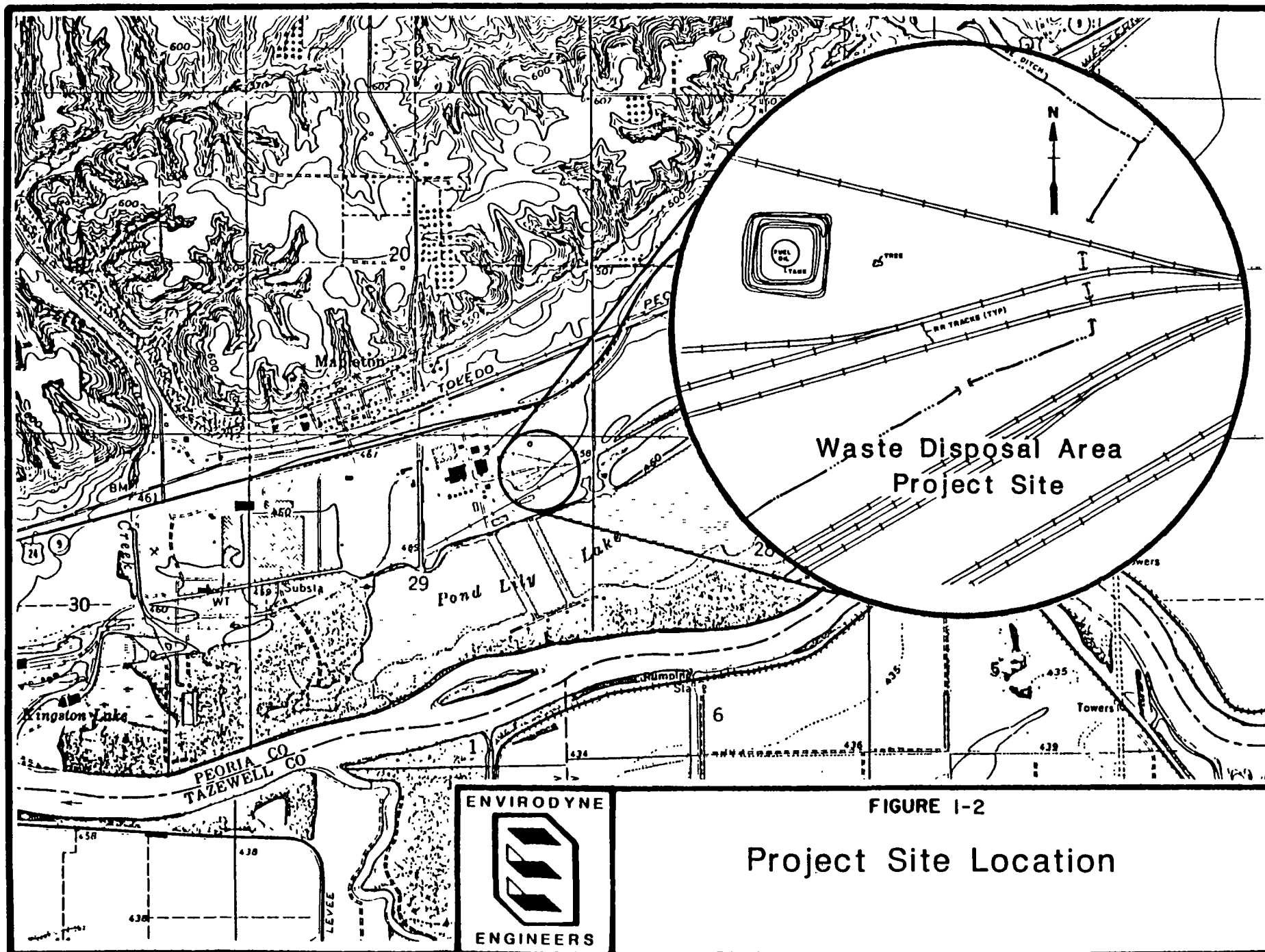
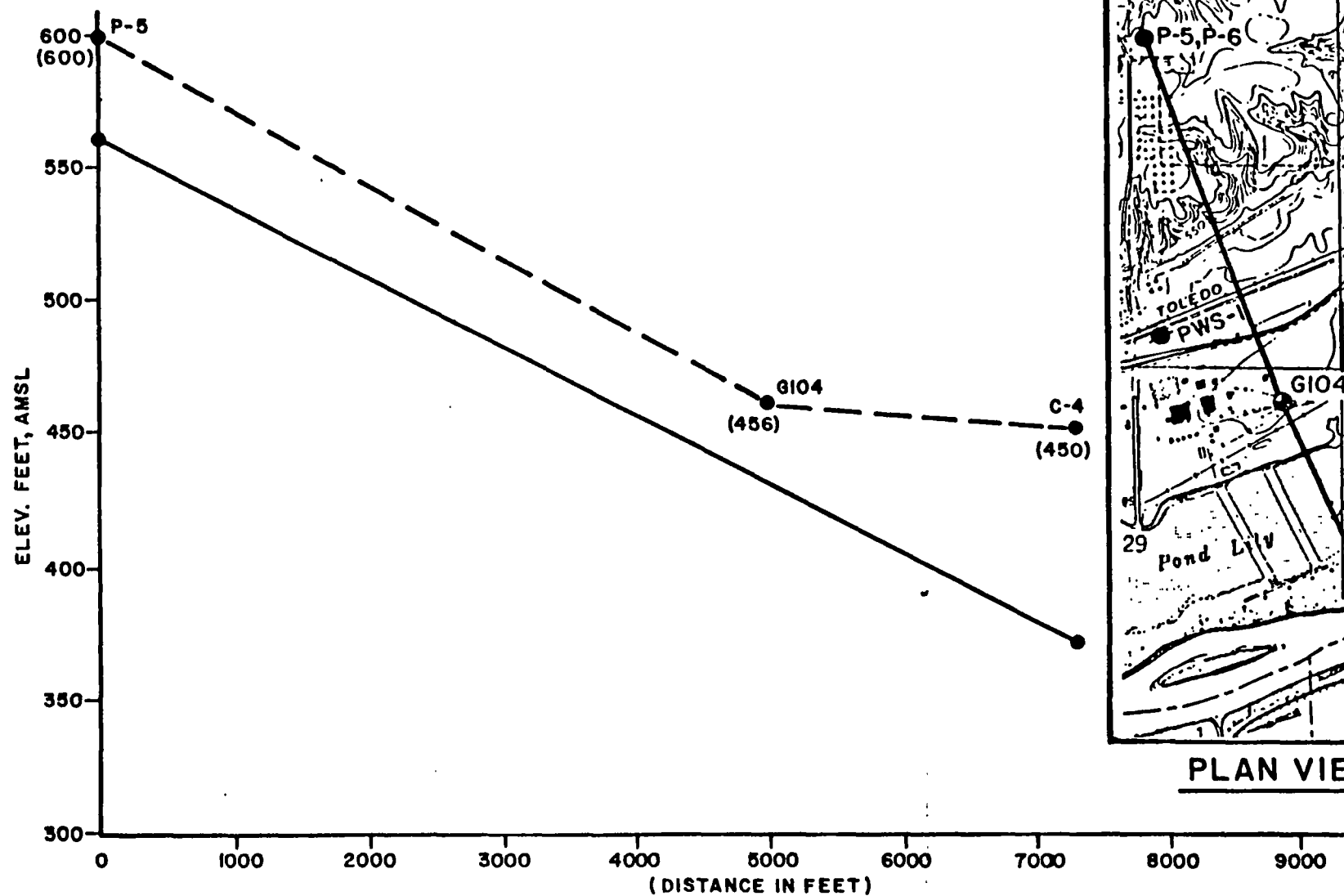


FIGURE I-2

Project Site Location



S-1



--- APPROXIMATE SURFACE ELEV.  
— APPROXIMATE BEDROCK ELEV.



FIGURE I-3

Regional Bedrock Cross-Section  
(P-5, G104, C-4)

Sherex purchased the property from Ashland Chemical Company in 1978. Ashland had previously purchased the property from Archer Daniels Midland (ADM) in 1967. ADM built the plant in 1962 and operated it until 1967.

#### 1.5 PAST INVESTIGATIVE ACTIVITIES

The Waste Disposal Area was reportedly used to dispose of liquid waste during an approximate 10 year period from the early 60s to the early 70s. During this period, an estimated 25,000 to 30,000 gallons of corrosive liquids containing cadmium were disposed of at the site. The waste liquid was generated from the cleaning of the High Pressure Alcohol process reactor. The periodic cleaning operation was prompted by the buildup of material on the reactor walls from the copper-cadmium catalyst used in the process. The plant used nitric acid to remove this material. The spent acid wash was transferred to a tank wagon, transported to the Waste Disposal Area and allowed to drain onto the ground. A file memorandum from Mayer, Brown and Platt (Sherex's attorney) indicated that the liquid waste was disposed of in a shallow trench. Flyash was mixed with nitric acid in this trench in an effort to neutralize the acid. The memo also stated that in approximately 1966 a storage tank was installed next to the reactor to hold used nitric acid between cleanings. When the acid could no longer be reused, it was transferred from the holding tank to a tank wagon for on-site disposal. Prior to installation of the storage tank, approximately 1,600 gallons of liquid were involved in a single disposal operation. After the storage tank was put into service, about 2,500 gallons of liquid were disposed of when the acid could no longer be used.

The Waste Disposal Area was originally identified as a potential hazardous waste site through the CERCLA process. A chronology of the events related to the discovery process are presented in Table 1-1. Sherex and Ashland submitted CERCLA 103C notifications to the regulatory agencies in June, 1981. The USEPA in turn performed a preliminary assessment in September, 1981. During the month of February, 1984, the USEPA performed a site inspection to obtain information for the Hazardous Ranking System (HRS) scoring. The HRS scoring was performed in March, 1984.

In November, 1984 Sherex contracted with Whitney & Associates, Peoria, Illinois to perform a borehole evaluation in the vicinity of the Waste Disposal Area. Approximately 40 boreholes were drilled to the shale depth during this evaluation. Soil samples were collected at five foot intervals within each borehole. These samples were analyzed for total and EP Toxicity cadmium. Results of these analyses indicated the presence of EP Toxicity cadmium above the level (1.0 mg/l) which defines a waste as hazardous. This area, less than 1 acre in extent, is shown in Figure 1-4. The highest EP Toxicity cadmium concentration (27 mg/l) was detected at the shale layer in the Sherex Boring Number 24.

In July, 1985, the Illinois EPA placed the Waste Disposal Area on the State Remedial Action Priority List (SRAPL). The IEPA in turn directed that an RI/FS be carried out.

TABLE 1-1

## CHRONOLOGY OF SITE ACTIONS

<u>Date</u>	<u>Event</u>
June 1981	CERCLA 103C Notification to IEPA from Sherex and Ashland
September 1981	USEPA Preliminary Assessment
February 1984	USEPA Site Inspection
March 1984	USEPA - HRS Worksheet
November 1984	Borehole Evaluation directed by Sherex included sampling and analysis for total and E.P. Toxic cadmium
July 1985	Site placed on IEPA SRAPL List
May 1987	Approval of Final POPR
July 1987	RI/FS site visit and waste characterization

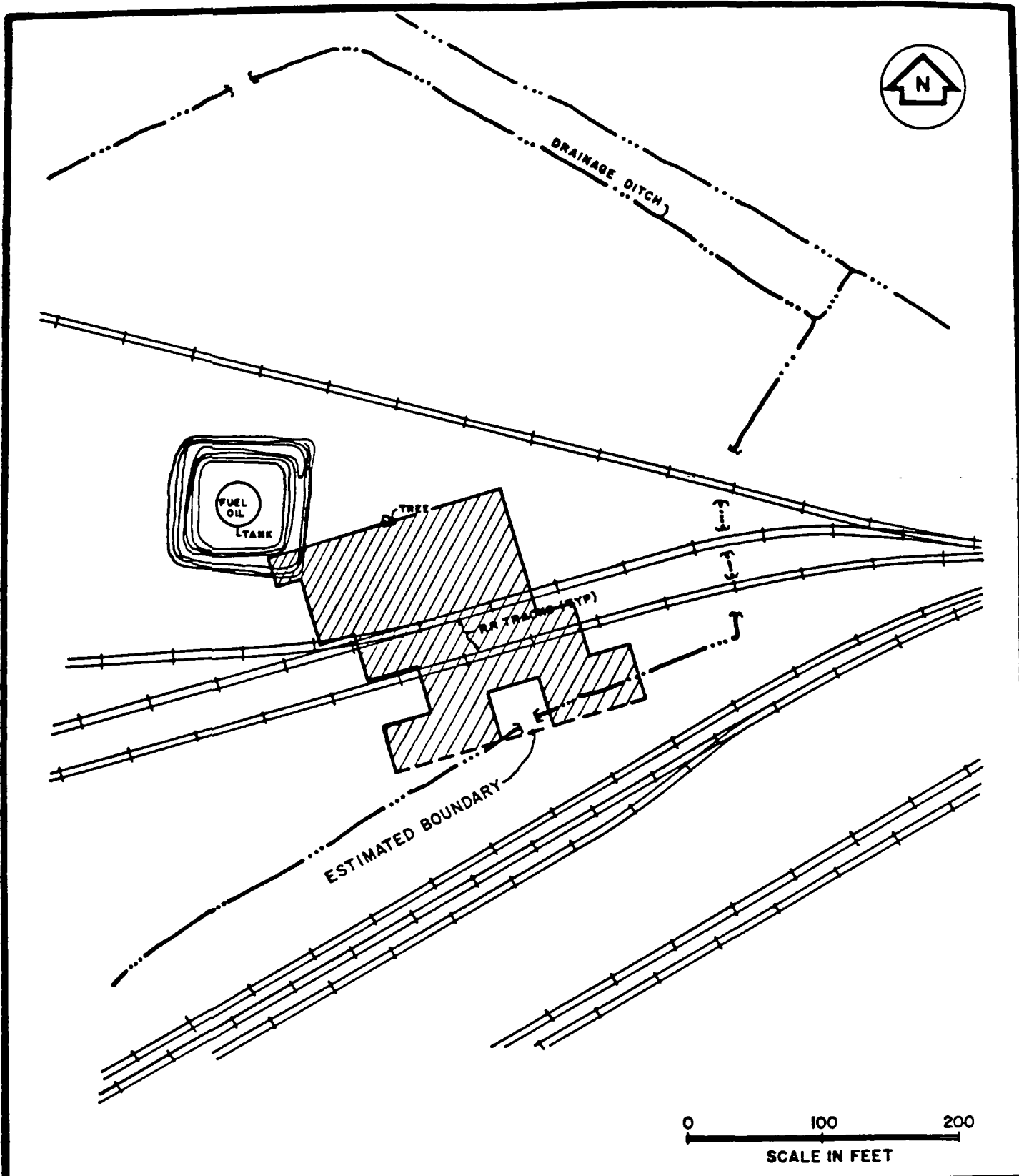


FIGURE 1-4

Approximate E P Toxicity Cadmium Boundary

ENVIRODYNE



ENGINEERS

## 2.0 SITE INVESTIGATIONS

### 2.1 INTRODUCTION

This initial phase of the RI focused on several site investigations to generate sufficient information for the assessment of remedial options to be evaluated during the feasibility study. Studies included a soils investigation, a geophysics investigation, a hydrogeologic investigation, and a surface drainage sediment investigation.

Prior to the performance of these investigations a site visit/waste characterization was conducted in July 1987 to gather information to assist in the development of investigation work plans. A review of historical process operations, raw material usage, and discussions with Sherex personnel were used to develop a preliminary Target Contaminants List (TCL) of substances which included nitrates, cadmium and copper. These were the compounds determined through this process to be within the Waste Disposal Area. In order to finalize the TCL ten soil samples from borehole B-7 were collected during the site visit/waste characterization for analysis. All ten samples were analyzed by EEI for the preliminary TCL parameters. Four of these samples were analyzed by the EEI laboratory for the complete USEPA Contract Lab Program (CLP) Hazardous Substance List (HSL) plus a number of additional compounds. The EP Toxicity extraction was performed for 24 metals and nitrates. Based on the results of the waste characterization analyses, the TCL was revised to include volatile organics and a Potential Contaminant List (PCL) was developed for the remainder of the field investigations. The analytical parameters for the investigations are listed in Table 2-1.

### 2.2 SOILS INVESTIGATION

A series of nine soil borings were drilled within and adjacent to the Waste Disposal Area to obtain depth-discrete soil samples for chemical analysis. The purpose of these samples was 1) to verify the results of the previous soil study conducted by Sherex in 1984, 2) to locate the lateral boundaries of the cadmium contamination, and 3) to determine the presence of other contaminants of concern.

The borings were located at positions around the Waste Disposal Area determined by IEPA as most likely to intercept contaminated soil from either the previous disposal activity or from contaminated groundwater which migrated from the Waste Disposal Area. The locations were designated B-1 through B-9 and are shown in Figure 2-1. Five of the nine holes were re-drilled with larger augers for installation of the groundwater monitor wells. Well installation is discussed in Section 2.3. One boring (B-7) was completed during waste characterization (July 1987) but was drilled using the same techniques as the other eight borings.

The eight remaining borings were drilled over a two-week period from September 9 through September 18, 1987. Drilling activities were performed by the IEPA Hydrogeologic Investigation Unit (HIU) crew using a CME-75 drill rig with 3-3/4 inch hollow stem augers (HSA) and five-foot continuous samplers. Soil borings were logged by the on-site IEPA geologist, who also directed the drilling activity.

TABLE 2-1

## ANALYTICAL PARAMETERS

Target Contaminant List (TCL)<sup>1</sup>

Cadmium  
Copper  
Nitrate<sup>5</sup>  
Volatiles (trichloroethene)

Potential Contaminant List (PCL)

Metals:	Aluminum	Mercury <sup>2, 5</sup>
	Antimony	Nickel
	Arsenic <sup>2</sup>	Potassium
	Barium <sup>2</sup>	Selenium <sup>2</sup>
	Beryllium	Silver <sup>2</sup>
	Calcium	Sodium
	Chromium <sup>2</sup>	Thallium
	Cobalt	Vanadium
	Iron	Zinc
	Lead <sup>2</sup>	Tin <sup>3</sup>
	Magnesium	
Inorganics:	Phenolics <sup>4, 5</sup>	
	Chloride <sup>5</sup>	
	Cyanide <sup>5</sup>	
	Nitrite <sup>3</sup>	
	Conductivity <sup>4, 6</sup>	
	pH <sup>6</sup>	
	TOC <sup>4, 5</sup>	
	TOX <sup>4, 5</sup>	
Organics:	Volatiles	
	Semi-volatiles with Library Search	
	Pesticides <sup>4</sup>	
	PCBs	

## NOTES:

<sup>1</sup>Trichloroethene added to TCL following Waste Characterization (WC)

<sup>2</sup>E.P. Toxicity metals analyzed in soil and sediment samples following WC

<sup>3</sup>Eliminated following WC

<sup>4</sup>Not analyzed in soils and sediments following WC

<sup>5</sup>Not analyzed in second round of groundwater samples

<sup>6</sup>Groundwater field measurement

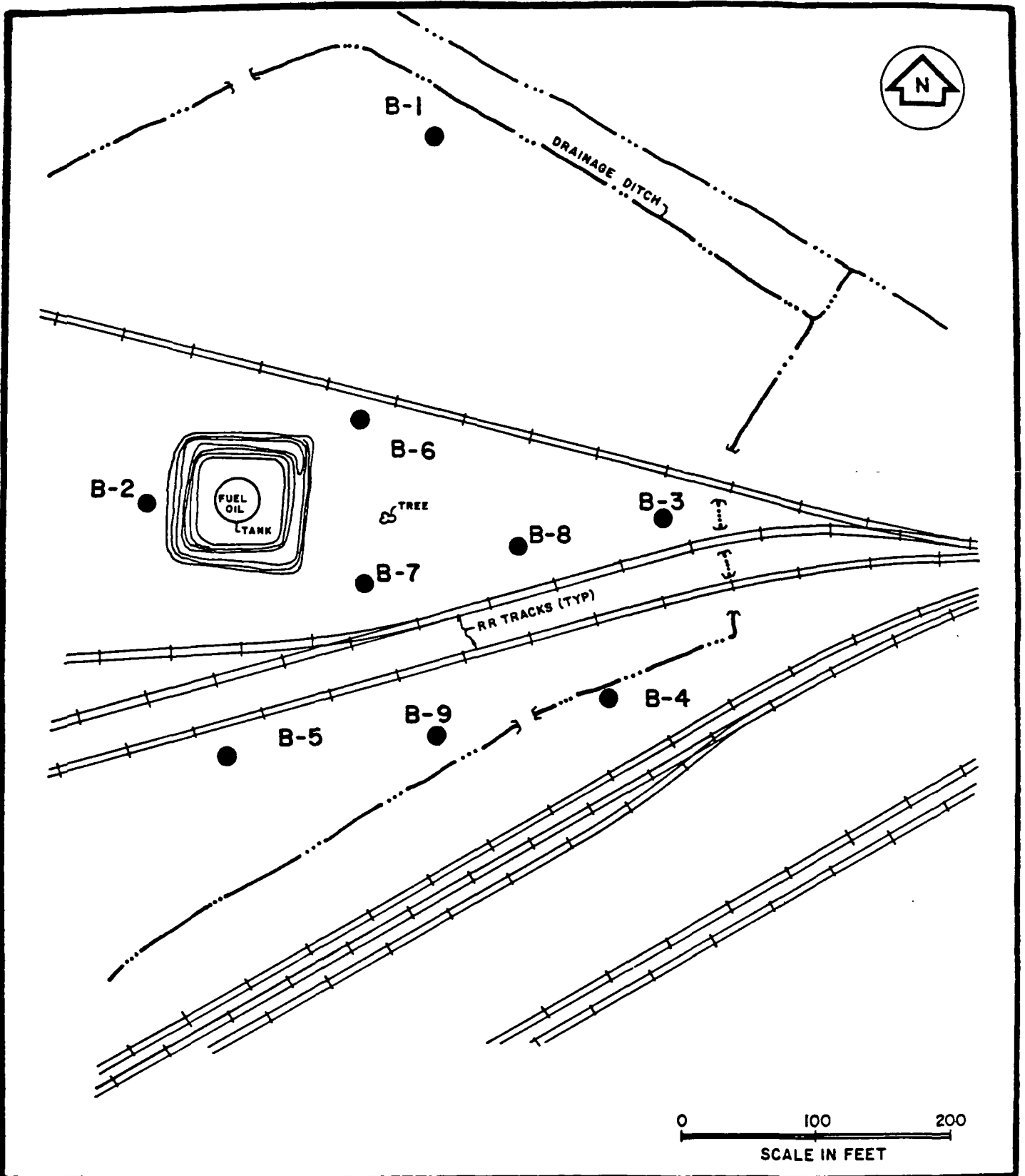


FIGURE 2-1

## SOIL BORING LOCATIONS

ENVIRODYNE



ENGINEERS

Completed log forms from each of the borings are presented in Appendix A. EEI personnel were responsible for collecting, describing and logging in all samples, initiating custody transfer, and delivering of samples to the laboratory.

Each boring was located in the field by the IEPA geologist and EEI personnel from points indicated in the Site Sampling Plan. All tools and equipment were decontaminated before the initial boring and between each boring and sample. Decontamination of all drilling equipment was performed by the IEPA drill crew. The decontamination of drilling equipment consisted of 1) high pressure hot water rinse, 2) rinse with 50%/50% mixture of deionized water and acetone, and 3) rinse with high pressure hot water. The procedure was repeated until all equipment was clean. A deionized water rinse was not used. The rinse water was from a source sampled and determined to be free of contaminants.

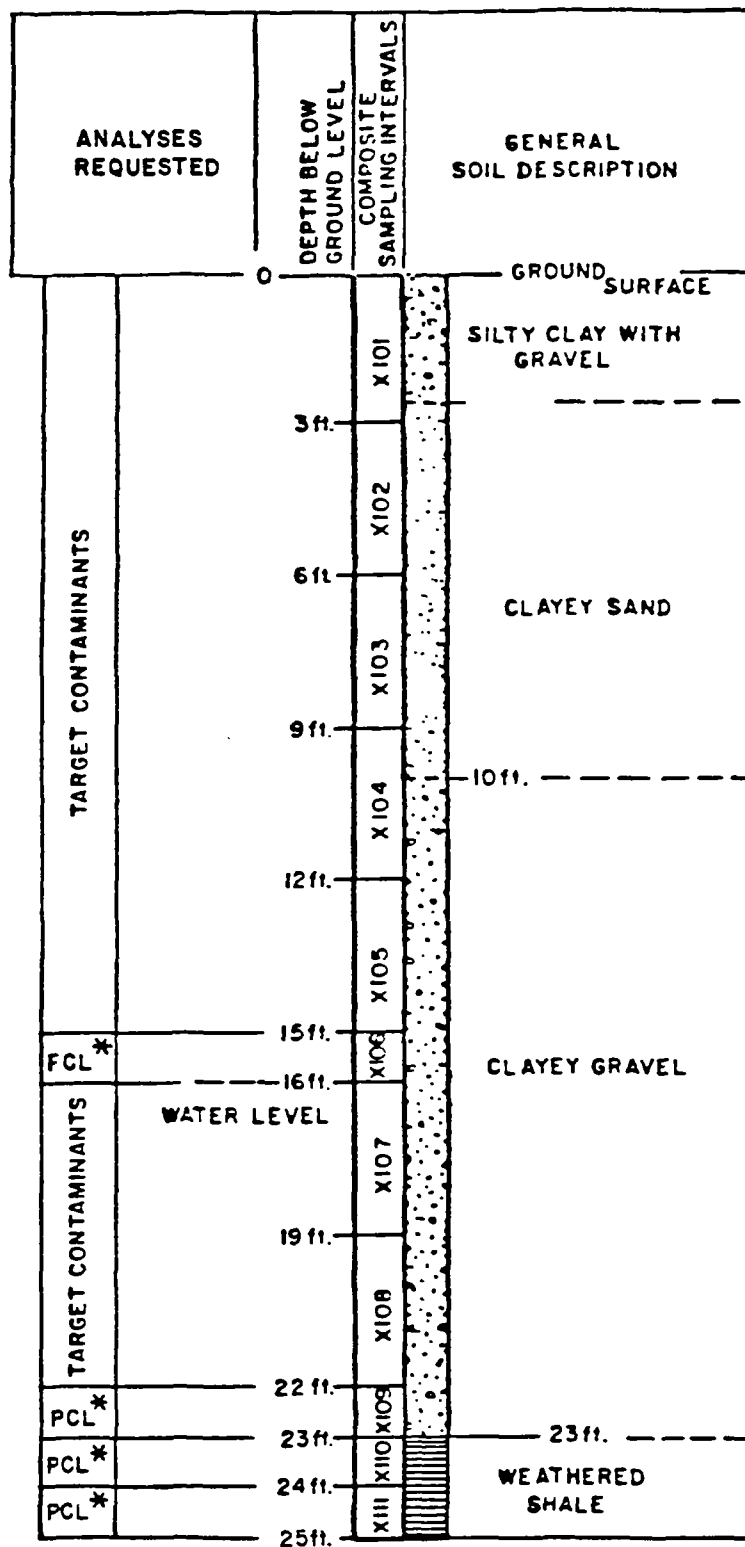
Equipment used by EEI personnel to collect and composite individual soil samples was decontaminated by EEI personnel between samples or borings. This equipment included stainless steel mixing pans, spatulas, and spoons. The same technique used to decontaminate drilling equipment was used, except steam cleaning was replaced with detergent solution scrubbing. For most borings, dedicated pans and mixing utensils were used for each sample interval and then cleaned at the completion of the boring.

Augers were advanced slowly with the continuous sampler head leading the auger cutting edge by approximately one inch. Soil samples were collected as the augers advanced. Samples were obtained at three-foot increments until the water table was reached. At the water table, a one-foot sample was collected. Below the water table samples were again collected at three-foot intervals until the shale or limestone bedrock layer was encountered. At this point, three one-foot samples were collected; one from above the shale and two from below the top of the shale. The augers were advanced to cover the depth of the desired sample interval, to avoid overlapping sample intervals, and to reduce possible mixing of interval designations. Figure 2-2 illustrates the generalized soil sample collection strategy.

As sample was retrieved, the continuous sampler was opened, and the EEI scientist collected the volatile organic fraction and then the Sherex split sample for volatile organics. The exposed sample was then measured and logged by the IEPA geologist. Samples were screened by the IEPA geologist and the EEI scientist with organic vapor detectors, including an HNU PI-101 and a Foxborough OVA. In addition, the cuttings and open borehole were monitored during drilling of the boring using these instruments and a combustible gas indicator. Sample was collected for the remaining parameters after the exposed core was logged. The three-foot sample intervals were analyzed for the TCL while a more extensive set of analyses was conducted on each of the one-foot depth discrete samples, the PCL compounds (See Table 2-1).

Samples were collected and sealed according to the IEPA CLP protocol and delivered to Daily Analytical in Peoria, Illinois by EEI personnel. Table 2-2 lists the summary of samples collected from the borings with associated depth intervals, collection dates and times, analysis requirements, Sherex splits, and monitoring readings.





NOTE: \* POTENTIAL CONTAMINANT LIST

ENVIRODYNE



ENGINEERS

FIGURE 2-2

## Generalized Soil Sampling Methodology

TABLE 2-2

## SOIL BORING SAMPLE COLLECTION SUMMARY

Boring Number	Date	Sample Identification	Depth Interval (ft)	Sample Time	Analysis Group <sup>a</sup>	Monitor Readings <sup>b</sup>		Sherex Split <sup>c</sup>
						HNU (ppm)	OVA (ppm)	
1	09/18/87	X101	0-3	8:40 AM	TCL	N/A	2.0	2
		X102	3-6	8:55 AM	TCL	N/A	3.0	2
		X103	6-9	9:00 AM	TCL	N/A	3.5	2
		X104	9-12	9:10 AM	TCL	N/A	20.0	2
		X105	12-15	9:20 AM	TCL	N/A	4.5	2
		X106	15-18	9:30 AM	TCL	N/A	3.0	1
		X107	18-19	9:45 AM	PCL	N/A	2.5	1
		X108	21-24.7	10:00 AM	PCL	N/A	2.5	1
		X109	25-26	10:10 AM	PCL	N/A	2.5	0
		X110	26-27	10:11 AM	TCL	N/A	2.5	0
2	09/16/87	X201	0-3	4:30 PM	TCL	N/A	7.0	2
		X202	3-6	5:00 PM	TCL	N/A	3.0	2
		X203	6-9	5:15 PM	TCL	N/A	3.0	2
		X204	9-12	5:25 PM	TCL	N/A	7.0	2
		X205	12-15	5:35 PM	TCL	N/A	6.0	2
	09/17/87	X206	15-18	11:05 AM	TCL	<1	3.0	2
		X207	18-21.5	11:35 AM	PCL	<1	6.0	1
		X208	21.5-22.8	11:50 AM	PCL	<1	7.0	1
		X209	22.8-23.8	11:55 AM	PCL	<1	7.0	1
		X210	25-26	12:05 PM	PCL	<1	4.0	0
3	09/10/87	X301	0-3	12:55 PM	TCL	10	7.0	2
		X302	3-6	1:15 PM	TCL	220	11.0	2
		X303	6-9	1:35 PM	TCL	1	3.0	2
		X304	9-12	1:55 PM	TCL	2	3.0	1
		X305	12-15	2:05 PM	TCL	2	3.0	2
		X306	15-18	2:20 PM	TCL	5	3.0	3
		X307	18-22	2:40 PM	PCL	4	4.0	0
		X308	22-23.2	3:00 PM	TCL	1	3.0	0
		X309	23.2-25.5	3:01 PM	PCL	1	3.0	0
4	09/15/87	X401	0-3	8:20 AM	TCL	0	<1	2
		X402	3-6	8:30 AM	TCL	0	7.0	2
		X403	6-9	8:45 AM	TCL	0	4.0	2
		X404	9-12	9:00 AM	TCL	0	4.0	2
		X405	12-15	9:10 AM	TCL	0	4.0	2
		X406	15-18	9:40 AM	TCL	0	2.5	2
		X407	18-22	9:50 AM	PCL	0	2.0	1
		X408	22-25	10:30 AM	PCL	0	4.0	0
		X409	25-29	10:45 AM	PCL	0	4.0	1
		X410	29-31	10:46 AM	PCL	0	2.0	2
5	09/16/87	X501	0-2	8:35 AM	TCL	0	3.0	2
		X502	3-6	9:00 AM	TCL	0	3.0	2
		X503	6-9	9:10 AM	TCL	0	5.0	1
		X504	9-12	9:20 AM	TCL	0	2.0	2
		X505	12-15	9:30 AM	TCL	0	2.0	2
		X506	15-18	9:40 AM	TCL	0	2.0	2
		X507	18-21	10:05 AM	TCL	0	3.0	0
		X508	22.3-23.5	10:15 AM	PCL	0	3.0	0
		X509	23.5-25	10:16 AM	PCL	0	5.0	0

NOTES: <sup>a</sup>TCL = Target Contaminant List;  
<sup>b</sup>PCL = Potential Contaminant List;  
<sup>b</sup>In borehole  
<sup>c</sup>0 = no samples split;  
1 = VOA only;  
2 = VOA and second container split  
3 = Wide-mouth container only;  
N/A - Denotes not applicable

TABLE 2-2  
SOIL BORING SAMPLE COLLECTION SUMMARY  
(Continued)

Boring Number	Date	Sample Identification	Depth Interval (ft)	Sample Time	Analysis Group <sup>a</sup>	Monitor Readings <sup>b</sup>		Sherex Split <sup>c</sup>
						HNU (ppm)	OVA (ppm)	
6	09/09/87	X601	0-3	3:10 PM	TCL	1	2.0	2
		X602	3-4	3:25 PM	TCL	1	2.5	2
		X603	5-8	4:25 PM	TCL	1	5.0	2
		X604	8-11	4:50 PM	TCL	1	2.0	2
		X605	14-17	5:20 PM	TCL	<1	4.0	0
		X606	19.5-20.5	5:40 PM	PCL	<1	3.0	0
		X607	20.5-21	5:41 PM	TCL	<1	3.0	0
		X608	21-23	5:50 PM	PCL	1	4.0	2
7  (Waste Characterization Boring)	07/20/87	X701	0-6	Not noted	TCL	2	4.5	Splits taken
		X702	6-9		TCL	2	3.5	but
		X703	9-11		TCL	2	1.2	not
		X704	11-12		PCL	2	1.2	recorded
		X705	12-15		TCL	2	1.0	
		X706	15-18		TCL	1.6	5.6	
		X707	18-21		TCL	5.6	-	
		X708	21.2-21.8		PCL	2	-	
		X709	22.2-23.2		PCL	2	-	
		X710	24-25		PCL	2	-	
8	09/09/87	X801	0-1.4	9:00 AM	TCL	3	7.0	2
		X802	3-6	9:15 AM	TCL	40	90.0	2
		X803	6-9	9:45 AM	TCL	3	2.0	1
		X804	9-13	10:00 AM	TCL	2	2.0	2
		X805	13-17	10:30 AM	TCL	2	2.0	2
		X806	17.8-18.8	10:50 AM	PCL	2	2.0	1
		X807	21-24	11:00 AM	TCL	2	2.0	0
		X808	24-24.5	11:25 AM	PCL	2	2.0	0
		X809	24.5-25.2	11:26 AM	PCL	2	2.0	3
		X810	25.2-26.4	11:27 AM	PCL	2	2.0	3
9	09/14/87	X901	0-3	2:15 PM	TCL	2.6	1000.0	2
		X902	3-6	2:40 PM	TCL	2	26.0	2
		X903	6-9	2:50 PM	TCL	1	20.0	2
		X904	9-12	2:55 PM	TCL	0.5	5.0	2
		X905	12-15	3:05 PM	TCL	3	11.0	2
		X906	15-18	3:30 PM	TCL	1	4.0	2
		X907	18-21	3:45 PM	PCL	70	5.0	0
		X908	21-22	4:00 PM	PCL	1540	3.0	0
		X909	22-23	4:01 PM	PCL	1540	3.0	3

NOTES: <sup>a</sup>TCL = Target Contaminant List;  
<sup>a</sup>PCL = Potential Contaminant List;  
<sup>b</sup>In borehole  
<sup>c</sup>0 = no samples split;  
1 = VOA only;  
2 = VOA and second container split  
3 = Wide-mouth container only;  
N/A - Denotes not applicable

Cuttings from each boring were collected in 55-gallon DOT 17H class open head steel drums, except for Boring 7 conducted during the waste characterization. These drums were sealed and labeled and left on-site next to each boring. Disposal is pending the outcome of sample analysis. Only cuttings from a single boring were contained in any single drum.

### 2.3 GEOPHYSICS INVESTIGATION

A geophysics investigation was carried out by Technos, Inc. in September 1987. This study was conducted to characterize the site geology and investigate the potential for contaminant plumes within the Waste Disposal Area. The methods used to perform the geophysics survey included seismic refraction and electromagnetic/resistivity. Seismic refraction was used to determine the depth to the top of shale bedrock. A combination of electromagnetic survey and resistivity soundings was used to evaluate the potential existence of any contaminated plumes. Refer to Technos' submittal, "Final Report: Geophysical Investigation at the Sherex Chemical Plant, Mapleton, Illinois," dated October 1987, for a more detailed discussion of the techniques used to evaluate this site. This report appears in Appendix B. Findings of the geophysics survey were incorporated into the hydrogeologic discussion located in Section 2.4.7 of this report.

### 2.4 HYDROGEOLOGIC INVESTIGATION

The hydrogeologic investigation activities included monitor well installation, well development/sampling and aquifer testing. These activities are summarized in the following paragraphs.

#### 2.4.1 Monitor Well Installation

A network of five stainless steel monitoring wells was installed to determine the extent of potential groundwater contamination around the Waste Disposal Area. The wells were placed in five coinciding borings drilled during the soil boring investigation discussed in Section 2.2. They were located in a pattern around the Waste Disposal Area determined most likely to intercept a potential contaminant plume. Figure 2-3 illustrates the locations of wells labeled G101 through G105.

These wells were intended to monitor the upper, unconfined sand aquifer above the shale/limestone bedrock. The wells were set to a depth just above the top of the shale from 22.0 to 26.1 feet below ground level. Figures 2-4 through 2-6 illustrate the construction details of each well against their associated geologic profiles. The reference lines for these three cross-sections are provided in Figure 2-7.

#### 2.4.2 Installation Procedures

Wells were placed in borings created by soil sample boreholes. Wells G101 through G105 were installed in borings B-1 through B-5, respectively. The boring created during sampling was reamed out with larger 6-1/4 inch ID hollow stem augers, with a reverse flight auger center pilot. The reverse flight auger was used to prevent cuttings from running up into the auger string. This method eliminated the need for using water during drilling of the wells.

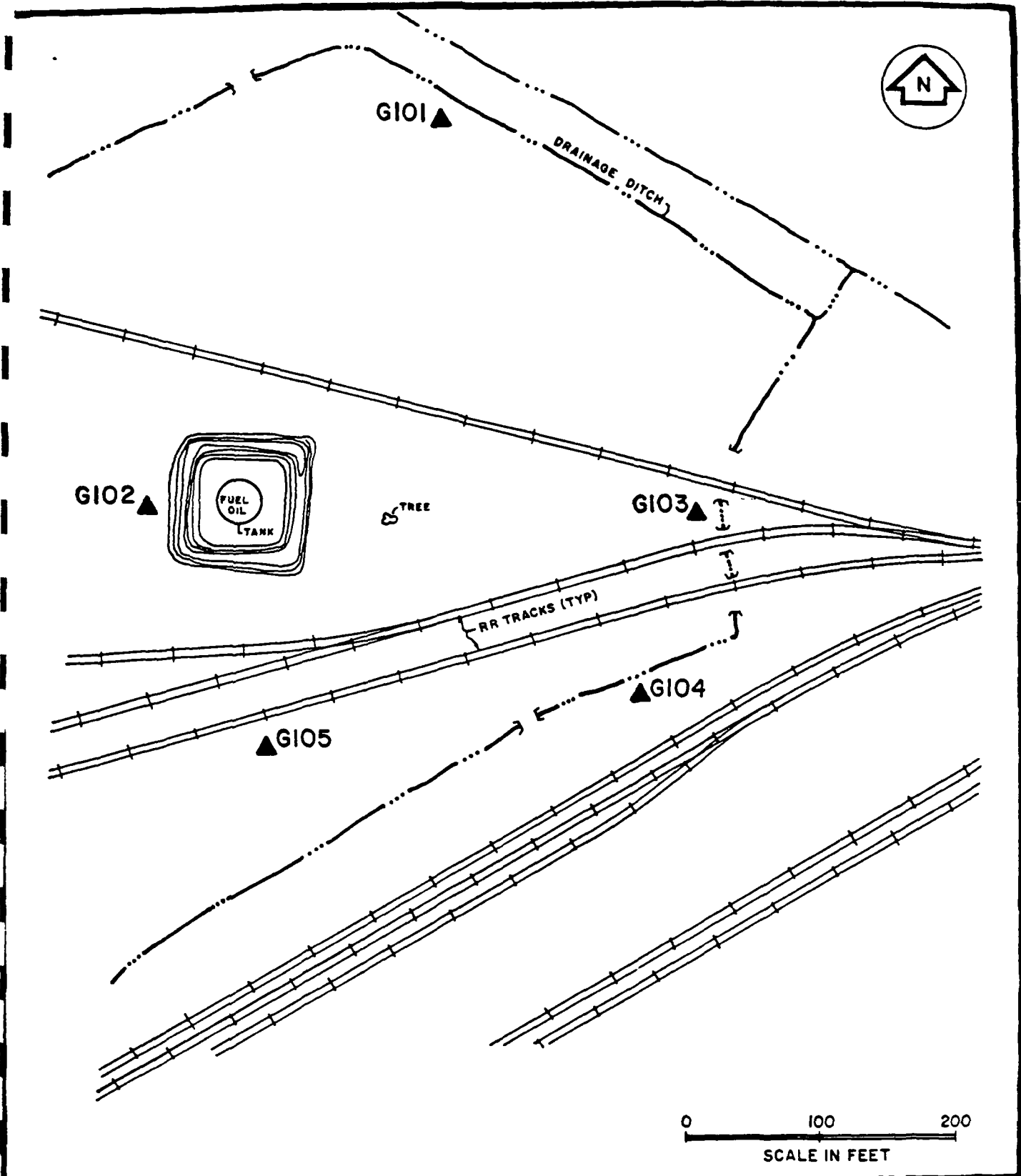


FIGURE 2-3

## MONITOR WELL LOCATIONS

ENVIRODYNE



ENGINEERS

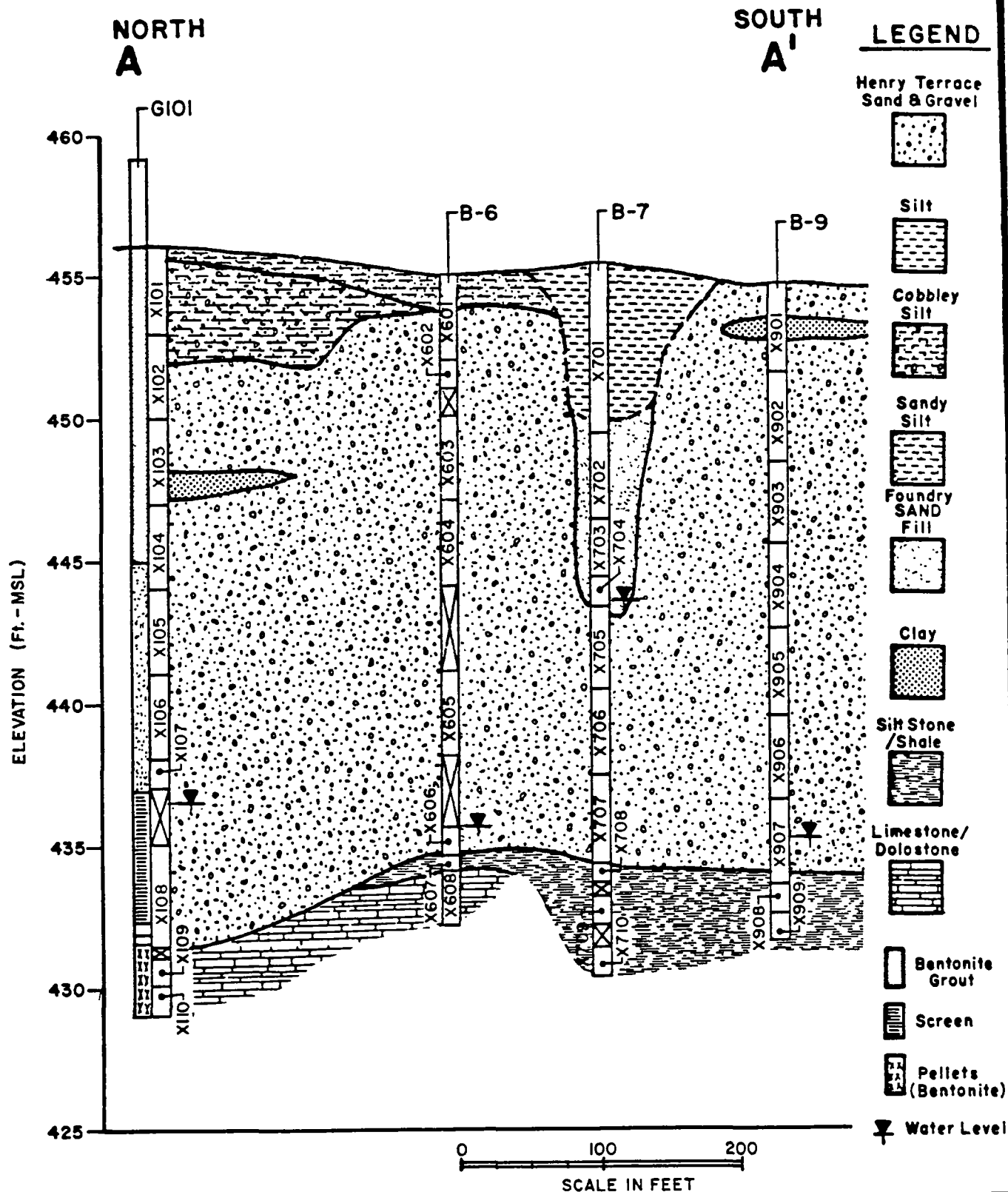


FIGURE 2-4

## Geologic Cross Section A-A'

ENVIRODYNE



ENGINEERS

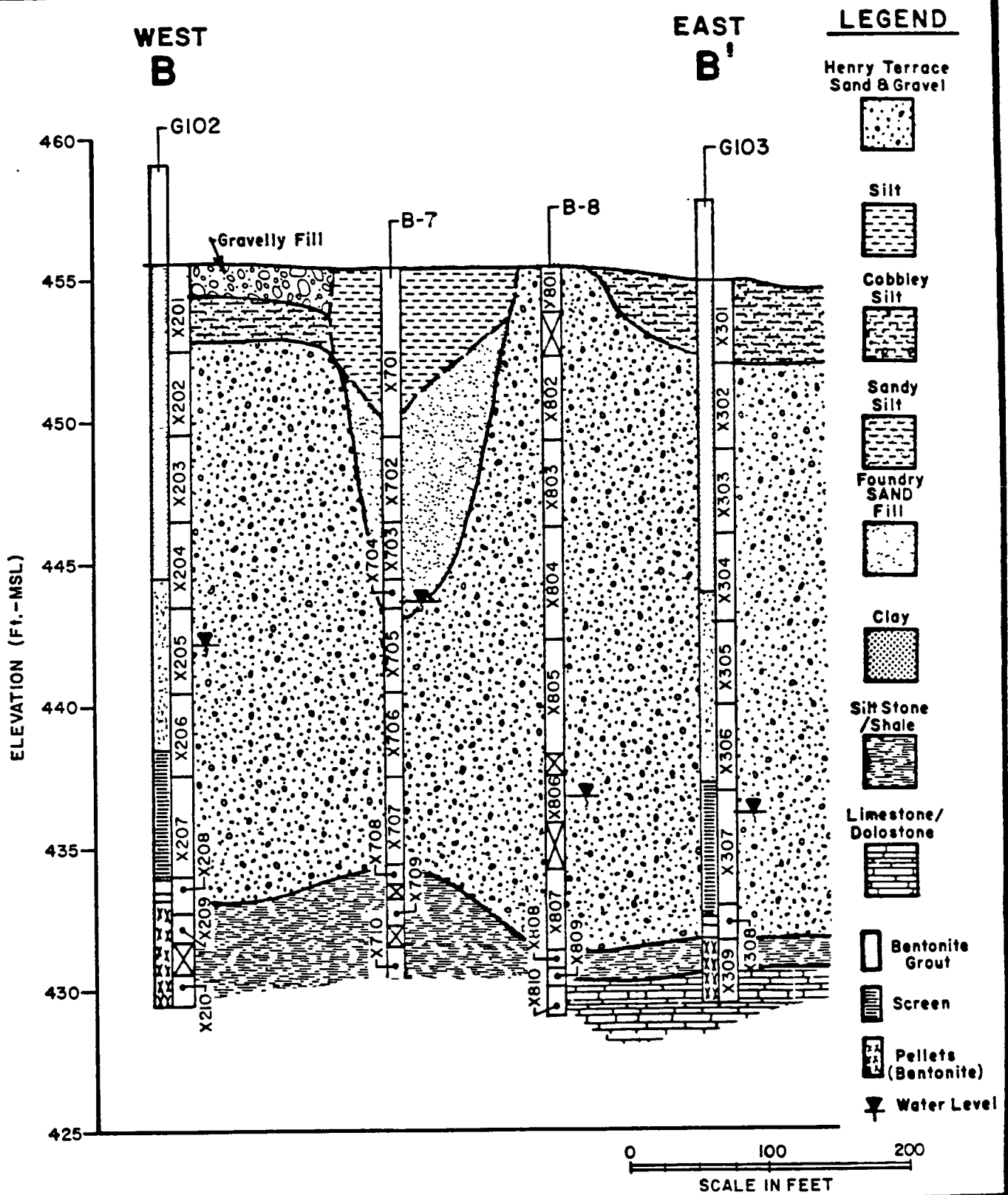


FIGURE 2-5

# Geologic Cross Section B-B'

ENVIRODYNE



ENGINEERS

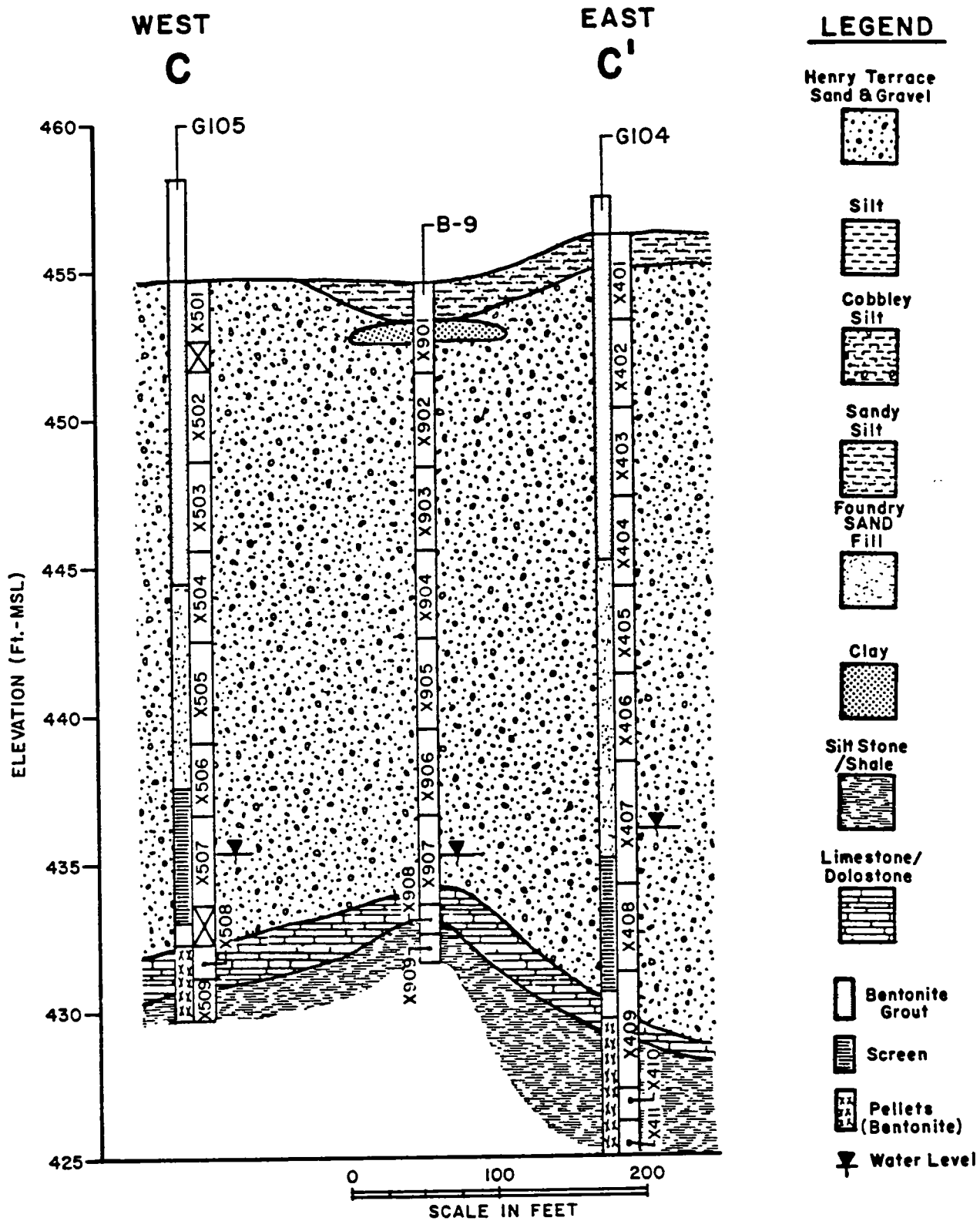


FIGURE 2-6

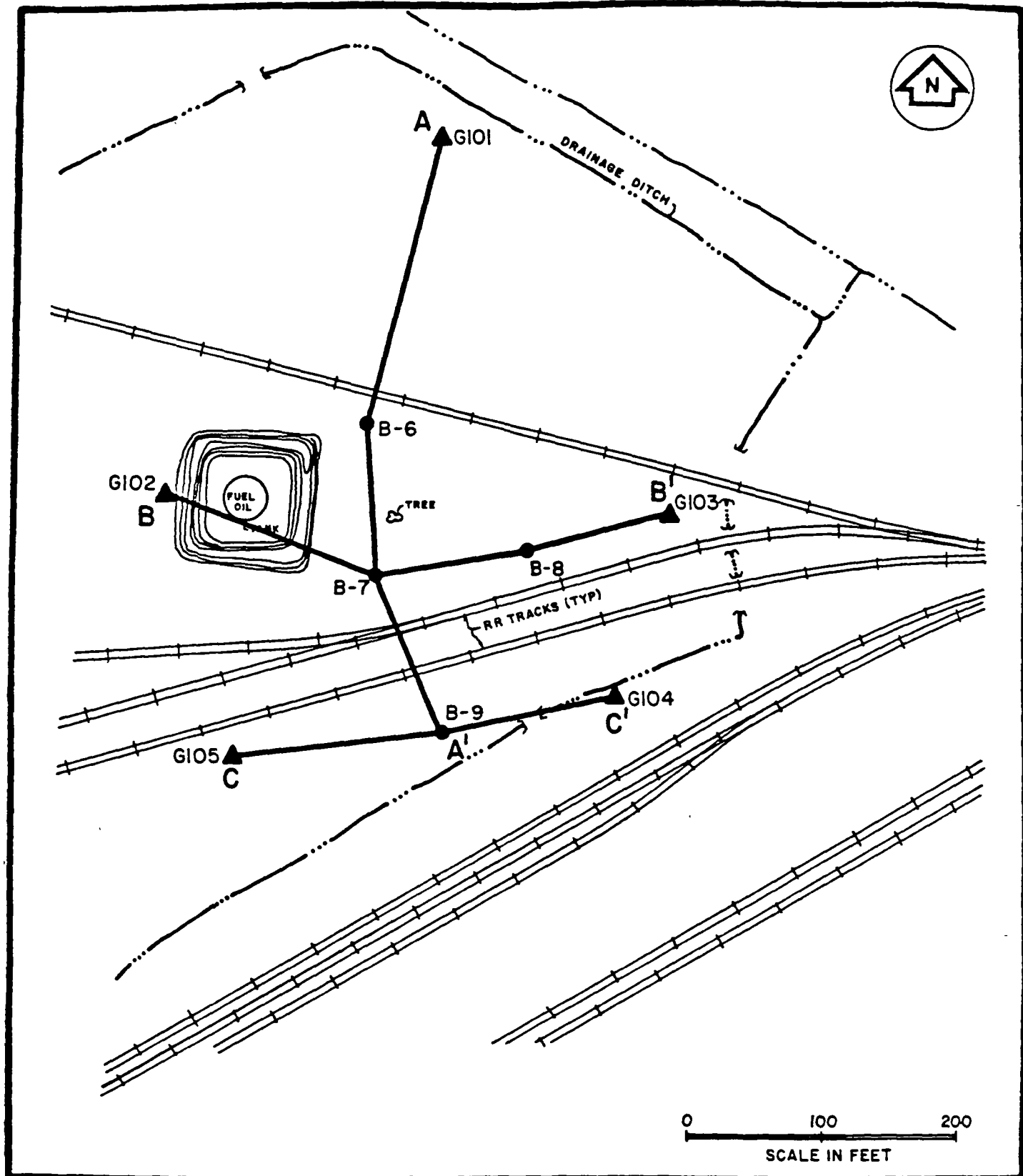
# Geologic Cross Section C-C'

ENVIRODYNE



ENGINEERS





ENVIRODYNE



ENGINEERS

FIGURE 2-7

## Geologic Cross-Section Reference Lines

The initial boring was usually taken two feet into the shale bedrock. This two-foot section of the boring was sealed with bentonite pellets to a point approximately 0.2 foot above the encountered top of shale. The bottoms of the wells were approximately 0.3 feet above the bentonite seals with some sand separating the bentonite from the bottom of the well.

Wells were constructed of two-inch ID No. 316 stainless steel. Screens consisted of two 2-foot sections coupled to create a four-foot screen length. A slot size of 0.01 inch was used on all screens. All well components were decontaminated prior to insertion into the borehole. The cleaning process included steam cleaning, rinsing with acetone and a final rinse with high pressure hot water. Threads were wrapped with Teflon tape before the sections were put together. Careful length measurements were taken of the various pieces to correlate proper depth placement in the borehole, with water table, screen length, and final top-of-casing.

The well string was placed through the hollow stem augers to the appropriate depth. A sand pack, consisting of fine Ottawa silica sand (0.42 to 0.44 mm), was placed in around the screen. The sand pack was added incrementally as the auger string was pulled. Due to the sandy nature of the surrounding strata, some cave-in of natural sands occurred with the addition of the sand pack. This sand pack and cave-in was continued to a point approximately 11 feet from the surface. The remaining length of the borehole was grouted to the surface with a mixture of 94 lbs. of Portland Cement, 50 lbs. of Ottawa silica sand and 5 percent bentonite by volume of grout. Well construction was completed by placing a steel protective pipe over the capped stainless steel well casing protruding above ground surface. Each protective casing was a pre-painted white steel pipe, four inches in diameter by five feet long, with a locking, hinged cap. All wells were locked with keyed-alike padlocks and labeled.

#### 2.4.3 Well Development

Wells were allowed to set for several days to allow the bentonite seals and the concrete grout to cure. The wells were developed following this settling period. Development was conducted to remove any caked-on fine silt or clay layers left in the sand pack or on the well screen surface which might inhibit flow to the well during sampling and testing. Development of the well was also performed to reduce the potential impact of grout mixture on water quality during sample analysis. Table 2-3 summarizes the well development notes.

All wells were developed using dedicated bailers made of either PVC, Teflon or stainless steel. Wells were developed using a surging action of the bailer to loosen soil particles, and draw them into the well. The particles were then removed by bailing. This was continued until the wells cleared to a visible and consistent state for several volumes. To avoid the potential for cross-contamination, bailers were dedicated to specific wells during the development process.

During development, volumes removed, pH, temperature and conductivity were periodically monitored and recorded. All wells were developed in accordance with the specifications in the Sampling Plan regarding stabilization of indicator parameters.

TABLE 2-3

## WELL DEVELOPMENT SUMMARY

Well Number	Date Installed	Date Developed	Top of Casing Static Water Level	Water Column Length	Volume To Be Removed*	Sediment Thickness Prior to Development	Sediment Thickness After Development	Water Quality Measurements				Remarks
								@	pH	E.C.	Temp.	
	1987	1987	ft-TOC*	ft	gal	ft	ft	gal	units	umhos/cm	°C	
G101	9-18	9-21	23.48	3.86	32	0	0	1/2 6 12 24 30 36	7.0 7.1 7.0 6.9 6.8 6.9	991 918 890 877 855 872	13.8 13.6 13.5 13.7 13.7 13.7	Recovery very good from initial bailing-cleared slightly - Teflon bailer
G102	9-17	9-21 9-22	22.42 22.46	2.96	25	0.08	0	1/2 1 2-1/2 4-1/2 6 7-1/2	6.6 6.6 6.5 6.6 6.8 6.7	1309 1252 1199 1077 1060 1054	19.2 19.7 17.9 17.8 17.8 17.8	Had to bail dry over several attempts - cleared slightly from initial bailings - very slow recovery throughout development - stainless steel bailer
G103	9-10	9-21 9-22	22.29 22.27	4.2	17	0.15	0	3/4 2-1/4 6 15 18	6.9 7.0 6.6 7.0 6.9	1667 1754 1722 1830 1829	14.5 14.2 14.2 14.0 14.0	Very slow recovery initially; recovery improved greatly over development time-cleared slightly - PVC bailer
G104	9-15	9-22	21.83	5.54	46	0	0	1/4 1-1/2 5 9 21 30	7.0 6.8 6.7 6.7 6.6 -	1542 1406 1443 1446 1450 -	16.1 16.1 16.3 16.5 16.4 -	Good recovery throughout development-remained turbid - PVC bailer
G105	9-16	9-22	22.35	3.00	25	0	0	1/4 1 2-1/2 4-1/2 6	6.5 6.8 6.4 6.5 6.6	1565 1526 1402 1217 1204	17.8 18.1 18.7 18.6 18.7	Bailed dry periodically, very slow recovery - cleared to slightly turbid after 3 gallons PVC bailer

\* Calculated volume of five times borehole volume - minus sandpack, plus well pipe volume in gallons at initial measurement (see logs for actual calculations).

#### 2.4.4 Sample Collection

The five monitor wells were sampled after allowing at least two weeks to pass following installation to allow aquifer conditions to return to pre-drilling status. Sample collection was conducted by EEI personnel on two separate occasions; October 14-15 and November 24, 1987. Table 2-4 summarizes the field conditions recorded at the time of each sampling episode. On both occasions, the procedures described in the subsequent paragraphs of this section were used to collect representative sample for analysis.

The water level of each well was measured with an electronic water level indicator prior to purging and sampling. The wells were then purged of a minimum of five well volumes using a Teflon bailer (wells with a slow recharge were purged over a period of time needed to remove five times the standing volume). Water quality parameters, including pH, Electrical Conductivity (EC), and temperature, were monitored using a Hydrolab Model 4041 throughout the purge. Upon removal of the required volume and when indicator parameters became consistent, the sample was collected. Samples were collected using the same Teflon bailer used during the purging. The bailer was cleaned in Alconox detergent solution with a nylon brush and rinsed several times with deionized water between wells.

The first round of groundwater sampling was performed on October 14 through 15, 1987. Samples were collected according to the IEPA CLP protocol. The analyses included volatile/semi-volatile organics, pesticides/PCBs, metals, phenolics, nitrates, cyanide, chloride, TOC, and TOX (See Table 2-1). The second round of samples was analyzed for volatile/semi-volatiles, pesticides/PCBs and metals. Fractions from these samples for dissolved metals and mercury were placed initially in a pre-cleaned, pre-filter bottle. This portion was then filtered through a 40-micron glass fiber filter using a portable peristaltic pump and filter stand assembly. All tubing and filter pieces were cleaned by rinsing with deionized water between samples. Filter pads were also replaced between each sample.

All aliquots were preserved with the supplied color-coded vials of preservative, as indicated on the chain-of-custody forms. Samples were then packaged and sealed according to the CLP procedures. Samples from both episodes of sampling were transported by EEI personnel to Daily Analytical, in Peoria, Illinois at the end of each day of sample collection.

#### 2.4.5 Aquifer Testing

Slug tests were performed at each well to determine hydraulic conductivity, transmissivity of the aquifer material and flow rate of the groundwater. The tests were conducted on October 15, 1987 by EEI personnel. The technique applied was a variation of the method described in Cooper, et al. (Water Resources Research, Volume 9, No. 4, 1087-1088, 1973). It consisted of removing a known volume of water from the well and immediately recording the recovery of that well. Recovery was monitored using an audible alarm on a water level indicator and logged with a stopwatch.

Most of the wells recovered quickly, usually in less than 60 seconds. Wells G103 and G104 recovered too quickly to get an accurate measurement. These wells fully recovered in less than 22 seconds. The remaining three wells recovered in periods of from 30 seconds to 11 minutes. A summary of the

TABLE 2-4

## GROUNDWATER MONITOR WELL FIELD DATA

Well Number	Date	Time	Top of Casing Static Water Level	Water Level <sup>a</sup> Elevation	Water Quality Measurements <sup>b</sup>			Remarks
					pH	E.C.	Temp.	
			Ft.	Ft. (msl)	Units	umhos/cm	°C	
G101	10-15-87	8:50 AM	23.85	435.43	6.9	860	13.3	
	11-24-87	8:30 AM	24.29	434.99	7.0	900	9.8	
G102	10-14-87	5:30 PM	22.61	436.46	6.6	1131	17.8	
	11-24-87	3:00 PM	22.98	436.09	7.2	1072	15.7	
G103	10-14-87	3:35 PM	22.71	435.03	6.9	1763	14.4	
	11-24-87	11:50 AM	23.33	434.41	7.3	1363	11.8	
G104	10-14-87	2:40 PM	22.29	435.02	6.6	1440	17.9	
	11-24-87	11:00 AM	22.89	434.42	6.8	1404	11.7	
G105	10-14-87	4:40 PM	22.71	435.48	6.9	1475	18.5	Very low yield collected sample over several trials (both sampling episodes)
	11-24-87	3:20 PM	23.29	434.90	7.7	1280	11.2	

<sup>a</sup>Water level elevation based on Surdex survey data.<sup>b</sup>Measured at time of sample collection.

results is presented in Table 2-5. A description of the Cooper, et al. test method is included in Appendix C, as are the calculations, type curves, and data plots used to derive the coefficient of permeability for the wells.

#### 2.4.6 Surveying of Monitor Well Locations

The locations and elevations of the five monitor wells and four borings were surveyed by Surdex Corporation on December 7, 1987. Prior to initiating the survey Surdex personnel discussed the availability of benchmarks near the site with Sherex personnel. Sherex personnel indicated that a benchmark (chiseled square on the retaining wall at the skimmer - elevation 455.10') existed on the Sherex property. The Surdex field crew confirmed that the elevation of this benchmark was consistent with the topographic map previously provided to EEI by Sherex. Surdex used this benchmark to complete the circuit for monitor well and borehole elevations. Table 2-6 lists the North and East coordinates and the elevation at ground level and at the top of the well casing with the cap removed. Surdex's closure for the survey was 0.01 feet. The reference point used for horizontal control was the intersection of the centerlines of East Street and the railroad spur adjacent to 3rd Street on the plant. This is an arbitrary reference point and not a USGS benchmark. All elevations were measured to mean sea level (msl) and coordinates from an arbitrary grid system. The measurements provided by Surdex were used to develop the maps and elevations presented in the text of this report. Adjustments to investigative field data were made as necessary.

#### 2.4.7 Hydrogeologic Investigation Results

The following discussion of site hydrogeology is based primarily upon the investigative procedure just described. In addition to the borings and wells installed during this investigation, the borings drilled by Sherex Company in 1984 and regional information supplied by area well logs were used in this interpretation. A brief summary of the hydrogeologic findings is presented initially, followed by a detailed discussion of site-specific stratigraphy and aquifer conditions and regional hydrogeologic conditions.

In general the site stratigraphy consists of a sandy silt to 1.2 to 5.6 feet deep over glacial sands and gravels of the Henry Formation to bedrock. Bedrock consists of silty shale and limestone and slopes toward the south and east from the Waste Disposal Area. Bedrock was encountered from 23.0 to 31.0 feet below ground level.

The water table was encountered in the Henry sands and gravel at depths ranging from 11.7 to 20.0 feet below ground level. Flow direction was determined to be east-southeast toward the Illinois River, at a calculated rate of 0.2 to 4 feet per day.

The borings drilled during this investigation and during the previous investigation conducted by Sherex were evaluated for this report. The borings show a general stratigraphy indicative of the regional geologic setting described in Section 1.3. Cross-sections illustrated in Figures 2-4, 2-5, and 2-6 show the materials encountered during drilling. A reference line for these cross-sections is shown in Figure 2-7. Cross-section A-A' (Figure 2-4) runs north to south across the waste disposal area. The background well G101 portrays a stratigraphy fairly typical of the cross-section. Boring B-1 for well G101 shows an upper layer of loess deposits of sandy and gravelly silt to a depth of 4.2 feet (452.4 feet msl). At this point the Henry Formation is encountered to a depth of 24.7 feet (431.9 feet msl). The Henry Formation is made up of glacial outwash sands and gravels varying in size from medium

TABLE 2-5

## Aquifer Test Results

Monitor Well No.	S	t sec	T cm <sup>2</sup> /sec	Ls cm	K cm/sec	i
G101	10 <sup>-7</sup> /10 <sup>-6</sup>	2.1/1.9	3.1/3.4	106.4	2.9 x 10 <sup>-2</sup> / 3.2 x 10 <sup>-2</sup>	0.0025
G102	10 <sup>-8</sup>	1.2	5.4	84.4	6.4 x 10 <sup>-2</sup>	0.007
G103	N/A	<0.6	>10.75	85.0	1 x 10 <sup>-1</sup>	0.002
G104	N/A	<0.6	>10.75	138.4	8 x 10 <sup>-2</sup>	0.002
G105	10 <sup>-6</sup>	9.7	6.65x10 <sup>-1</sup>	79.6	8.4 x 10 <sup>-3</sup>	0.003

t = from curve matching

$T = \frac{rc^2}{t}$  = Transmissivity       $rc^2$  = radius of casing - squared, in cm<sup>2</sup> (6.45 cm<sup>2</sup> for all wells)  
t = time in sec.

Ls = saturated screen length in cm.

$K = \frac{T}{Ls}$  = coefficient of permeability in cm/sec.

i = horizontal gradient

N/A = Not available, recovered too quickly to obtain a measurement.

TABLE 2-6

## SUMMARY OF SURDEX SURVEY MEASUREMENTS

Well Location	<u>North</u> ft	<u>East</u> ft	<u>Top of Casing</u> ft-msl	<u>Ground</u> ft-msl
Well G101	11014.65	11509.88	459.28	456.06
Well G102	10819.33	11240.18	459.07	455.62
Well G103	10702.84	11595.20	457.74	454.90
Well G104	10588.70	11520.78	457.31	456.08
Well G105	10621.89	11234.45	458.19	454.79
Borehole B-6	10828.88	11396.22	N/A	455.10
Borehole B-7	10718.39	11372.61	N/A	455.48
Borehole B-8	10706.36	11486.99	N/A	455.27
Borehole B-9	10593.79	11391.28	N/A	454.71

Note: N/A denotes not applicable



sand to large cobbles. Stratification is evident with occasionally encountered layers of well-graded sand interspersed with the generally poorly graded sands and gravels in relatively thin bands of 1 to 3 feet thick. A thin seam of sandy clay was encountered from 8 to 9 feet deep within the sand and gravel layers. Water was encountered at 19.5 feet below ground surface.

Bedrock in this boring was encountered at 24.7 feet, at an elevation of 431.9 feet msl. It consists of a grey, very dense, argillaceous limestone with shaley zones in the bedding plane fractures. Vertical fractures were noted in the upper bedrock layer from 25 to 25.7 feet. This boring was completed to 27.0 feet, drilling 2.3 feet into the bedrock.

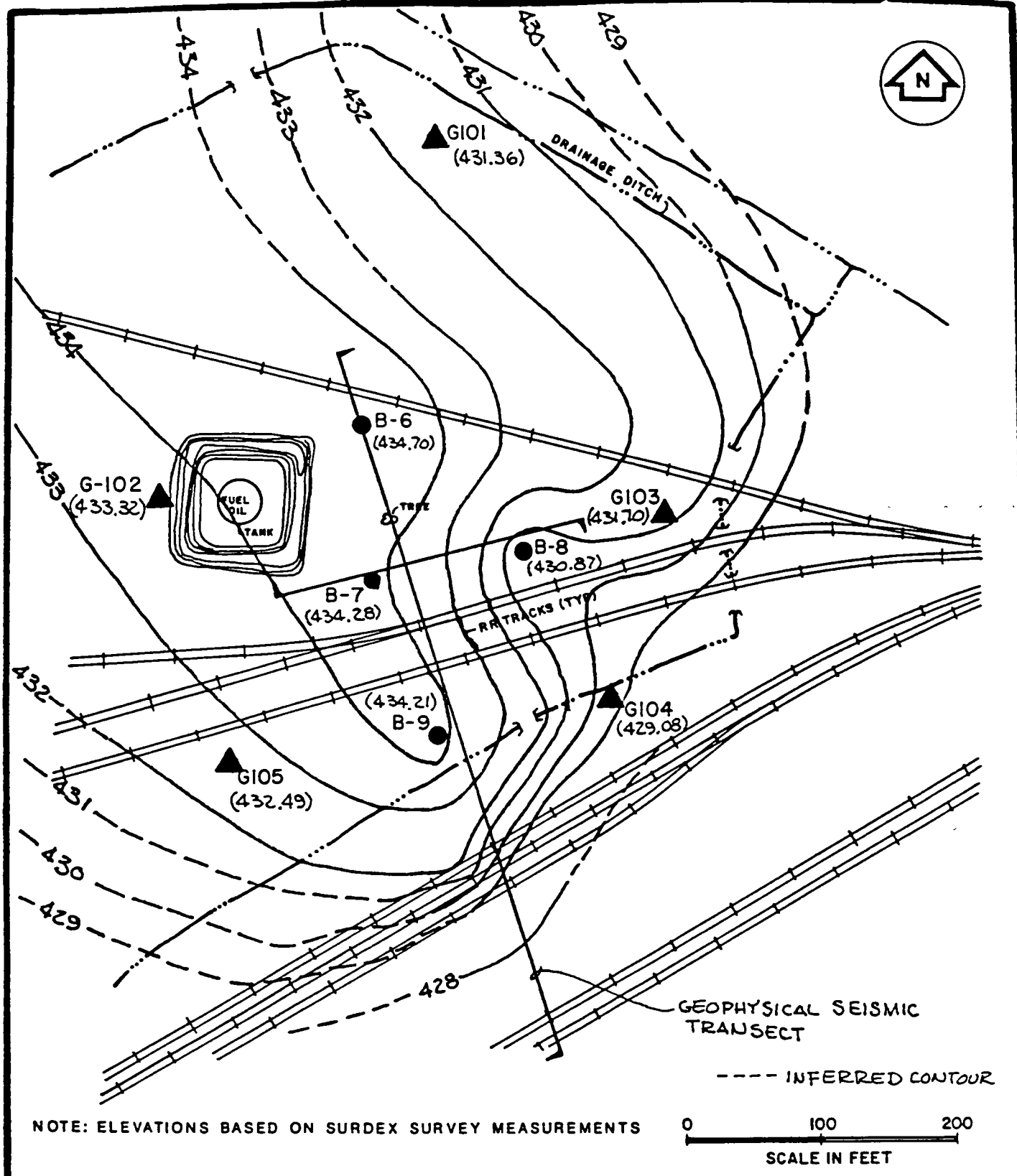
This same general stratigraphic profile was repeated across this north-to-south cross-section, (A-A') and found in the other borings conducted during this investigation. In general, a sandy silt or sandy clay overlies the Henry sands and gravels to a depth of 1.2 to 5.6 feet from the ground surface. Similar zones of sand and gravel were encountered to bedrock across all borings in this area.

The bedrock erosional surface slopes down toward the south and east from the Waste Disposal Area. Generally, the bedrock consists of silty shale, calcareous siltstone, or argillaceous limestone. Fractures were noted in the upper several inches of the siltstone and limestone. Beyond this depth, fracturing was not evident.

Based on the two seismic lines layed out perpendicular to each other during the geophysical investigation, the bedrock surface elevation decreases towards the south. Figure 2-8 shows the bedrock contours, as plotted from these investigation borings around the Waste Disposal Area. The references used to generate this map included data from the geophysical investigation and the investigation borings as shown in Figures 2-4 through 2-7.

The initial waste characterization boring (B-7) was drilled near the center of the waste disposal area. This boring encountered a fill sand, appearing to be foundry sand, with a silty very fine to medium-grained black sand to a depth of approximately 12.3 feet. Borings from the 1984 Sherex investigation delineated a sand-filled trench excavation, which was apparently used as part of the Waste Disposal Area. Figure 2-9 illustrates the extent of this trench as indicated by the Sherex borings. This trench extends down to a maximum measured depth of 13.5 feet below ground level, and is approximately 100 feet long. The trench's shallowest point is 2.5 feet below ground level and averages 5.25 feet deep. The width could not be determined from these borings. In B-7 the Henry Formation was again encountered below 12.3 feet. The Henry Formation became increasingly gravelly with depth, and a green-blue coating appeared on the calcareous gravel near the top of bedrock. The green-blue coating was possibly the precipitate of cupric hydroxide formed from the copper component of the waste. The intensity and distribution of the coating became greater with depth until the bedrock was encountered. B-7 was the only location in which this condition was encountered.

The water level in B-7 was encountered at 11.7 feet, coincident with the point of the foundry sand fill and Henry Formation interface. This boring, however, was drilled several weeks prior to the remaining borings. Water levels in the remaining borings were much lower at the time of their drilling.



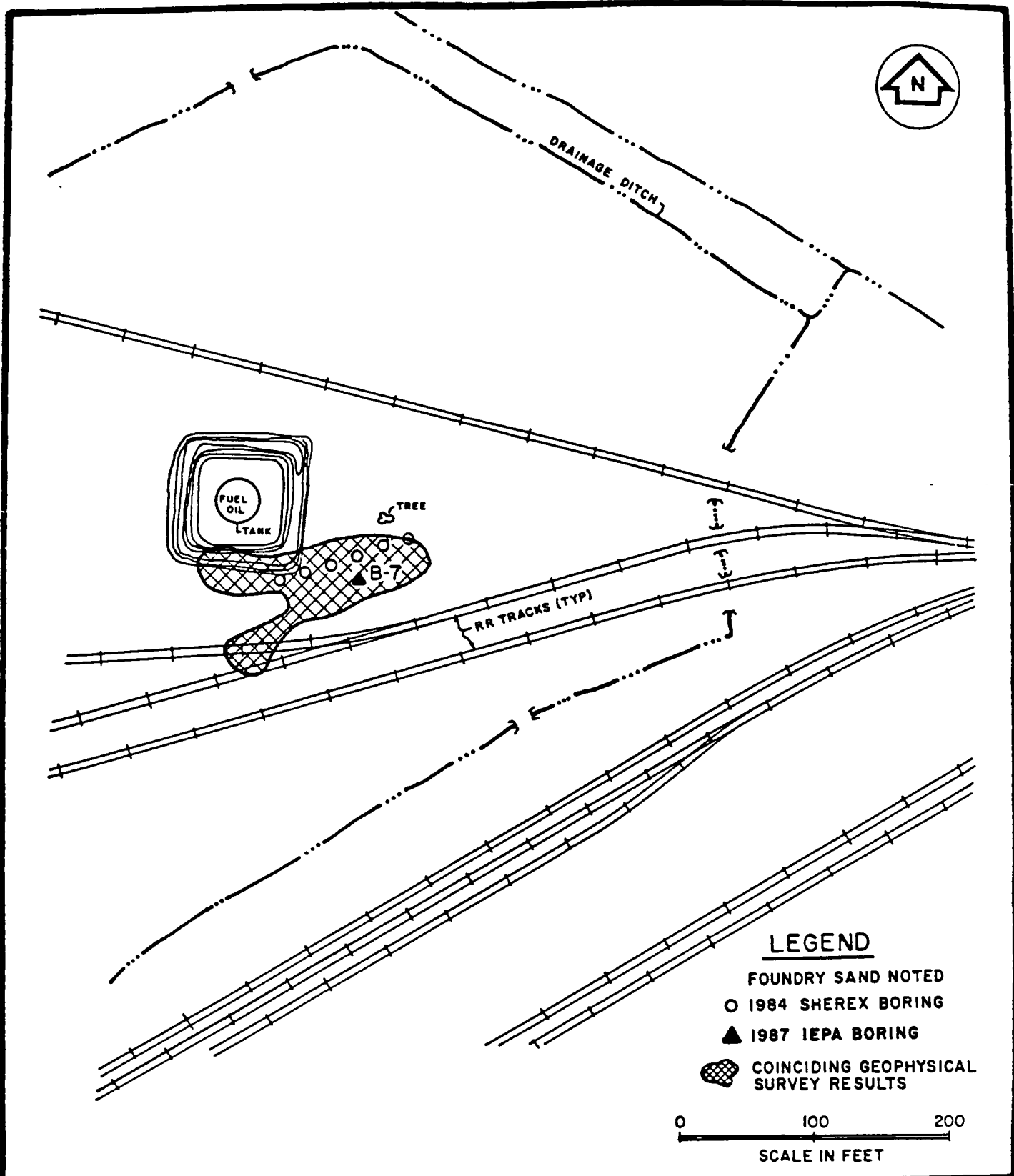
ENVIRODYNE



ENGINEERS

FIGURE 2-8

Top of Bedrock (ft.-MSL)



ENVIRODYNE



ENGINEERS

FIGURE 2-9

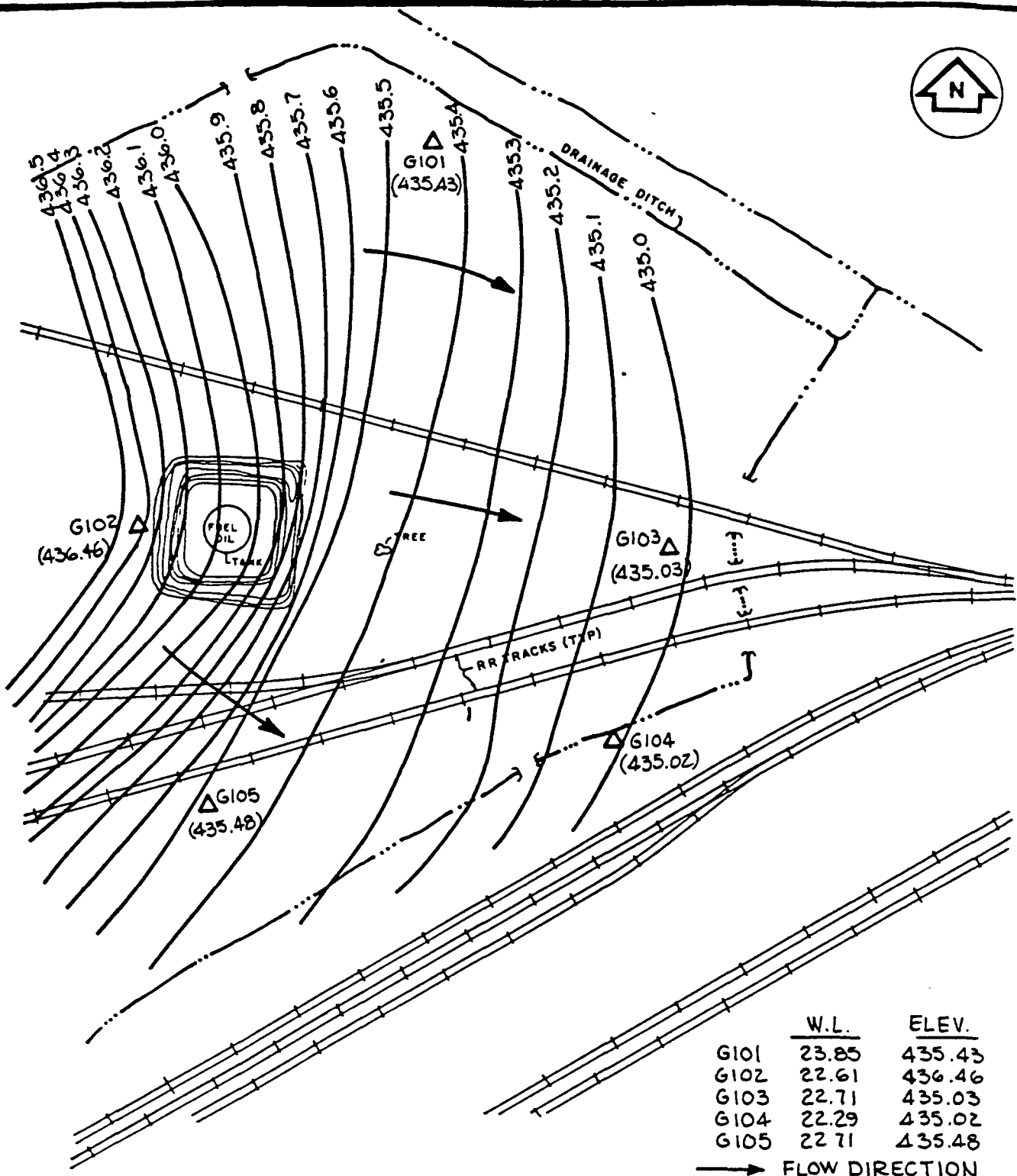
## Fill Trench Delineation

The two sample collection rounds and the aquifer test effort provided water table elevations and groundwater contours of the site. Figure 2-10 provides a representation of the water table contours for the initial sample collection round on October 14, 1987 based on the water levels measured in the monitor wells and an understanding on the site conditions. Water levels measured on other visits to the site produced nearly duplicate versions of the map shown in Figure 2-10. These additional contour maps are included in Appendix C, along with other aquifer test data.

Generally there is an east-southeast component to the groundwater flow toward the Illinois River in the vicinity of the Waste Disposal Area. The aquifer test data, as noted in Table 2-5 indicates a range in hydraulic conductivities from  $8.4 \times 10^{-3}$  cm/sec (G105) to  $>1 \times 10^{-3}$  cm/sec (G103) for the sand and gravel aquifer. Horizontal gradients across these wells ranged from 0.002 to 0.007 feet per foot, producing a groundwater flows of from 0.2 to 4 feet per day. This flow rate only applies to the area in the immediate vicinity of the monitor well network and does not consider two wells (G103 and G104) which recovered too quickly for slug test analysis. These data confirmed the positioning of Wells G103, G104, and G105 as downgradient of the Waste Disposal Area.

Information was obtained from other wells drilled for industrial supplies in the vicinity of the site. These on-site production wells are not used for drinking purposes. Wells located on Sherex property, approximately one-half mile closer to the river than the monitor wells, were drilled to depths of approximately 80 feet. Other wells to the east, southeast, and southwest of the site have also been noted. Table 2-7 presents information for a several of supply wells. Information presented in the table includes the approximate distance and direction from the site, total depth, bedrock depth, water level, and other available data. These well logs indicated that the sand and gravel layers are continuous to the bottom of each of these wells and confirmed the usage of this shallow aquifer for domestic and industrial supply. Bedrock depth was determined to be 375 feet msl in proximity to the Illinois River south of the site, and 435 feet above msl between the river and the plant. This information further confirmed that the top of bedrock slopes down toward the south and east as indicated by geophysics and boring logs. Because of insufficient data, it is not known whether the shale is eroded and filled with fluvial deposits or is continuous in the vicinity of the site. The resulting hydrologic regime is similar under either situation. The shallow aquifer is continuous to the top of bedrock. Water supplies are being drawn from this shallow aquifer just above the bedrock surface.

The hydrogeology of the region, as it relates specifically to this site, is affected by the impact of the Illinois River on the shallow water table. There are no monitor wells or piezometers situated in position to evaluate the flow pattern beyond the Waste Disposal Area. However, from logs of wells installed for commercial water supply in the area, an indication of the overall hydraulic regime was gained. Water tables in these supply wells were in the range of 10 to 14 feet from ground surface. These levels correspond with those found in the monitor wells at the site. The supply well logs further indicated a shale bedrock depth lower than the on-site vertical bedrock elevation. There was no other hydraulic barrier found in the supply well logs to indicate that an aquifer other than the one being evaluated by the monitor well network is being used by these supply wells.



	W.L.	ELEV.
G101	23.85	435.43
G102	22.61	436.46
G103	22.71	435.03
G104	22.29	435.02
G105	22.71	435.48

→ FLOW DIRECTION

0 100 200  
SCALE IN FEET

NOTE: ELEVATIONS BASED ON SURDEX SURVEY MEASUREMENTS

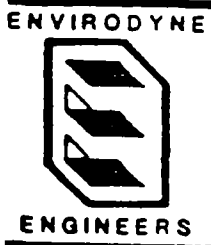


FIGURE 2-10

Water Level Measured 10-14-87  
(Sample Round 1)

TABLE 2-7

## LOCAL SUPPLY WELL INFORMATION

Well Number	Total Depth (ft)	Aquifer Material	Depth to Shale (ft)	Water Level (ft)	Distance from WDA <sup>1</sup> (ft)
	(below grade)		(below grade)	(below grade)	
C-3	32	Sand	36	unknown	6500 SW
C-4	82	Sand, gravel, boulders	80	10	2500 S
C-5	79.5	Sand, gravel, boulders	Not encountered	11	2500 S
P-15 <sup>3</sup>	30	Gravel	16	14	8500 ENE

Notes: <sup>1</sup> Waste Disposal Area (WDA)  
<sup>2</sup> Commercial Wells (C)  
<sup>3</sup> Private Wells (P)

The impact of the Illinois River on shallow groundwater would result in a gradual shifting flow direction on-site from east-southeast to south, then to the southwest to correspond with the river surface flow direction. The exact contouring cannot be determined at this point from the available data. Additional factors which may influence groundwater flow direction and rate are the aeration pond, Pond Lily Lake between the site and the river and the supply wells on the Sherex property. The pond may act as a recharge basin and possibly provide a groundwater mounding influence. The Sherex wells may create a draw-down effect on the groundwater.

Flow rates would change as groundwater approaches the river and the aquifer becomes thicker. Available pump test data revealed that a rate of over 1,000 gallons per minute is probable, with an in-well drawdown of only two feet over an 8 hour period (ISWS, 1987). All pertinent data covering the local wells was obtained from the Illinois State Water Survey. This information appears in Appendix D.

## 2.5 SURFACE DRAINAGE SEDIMENT INVESTIGATION

Sediment samples were collected for chemical analysis from four locations within the on-site surface water drainage system. The sample locations were selected from locations surrounding the Waste Disposal Area in an effort to characterize the potential impact of this area upon the surface drainage system. Sample locations were designated X001 through X004 and are shown in Figure 2-11. The rationale for selection of the sites follows:

X001 represents an upstream location north of the Waste Disposal Area. The ditch was approximately four feet wide at water level and 12 to 18 inches deep at the center. Sample was reddish brown sandy silt covered by a thin (approximately one-half inch) layer of gelatinous algae. Sample had a musty odor but produced no HNU readings.

X002 represents the initial drainage point approximately 140 feet south of the Waste Disposal Area. The ditch was approximately five feet wide at water level with six to ten inches of water. Vegetation growth was heavy across the width of the ditch. Sediment was reddish brown silt with a thin gelatinous layer over the top and had a faint unidentifiable odor. No HNU readings were produced.

X003 was collected downstream of the Waste Disposal Area in the same ditch as X002 and approximately 400 feet downgradient of X002. The ditch was five feet across at water level and ten inches deep. Sediment had a layered characteristic of gelatinous material and sand in approximately one-half inch layers. No odor was detected or HNU readings produced.

X004 represents the off-site location after the confluence of ditches represented by samples X001 and X003 and the off-site drainage. The ditch was approximately eight feet across and four inches deep. Vegetation was thick across the entire width. No odor was detected or HNU readings produced. Sample was dark brown silt and had a thin gelatinous layer on top.

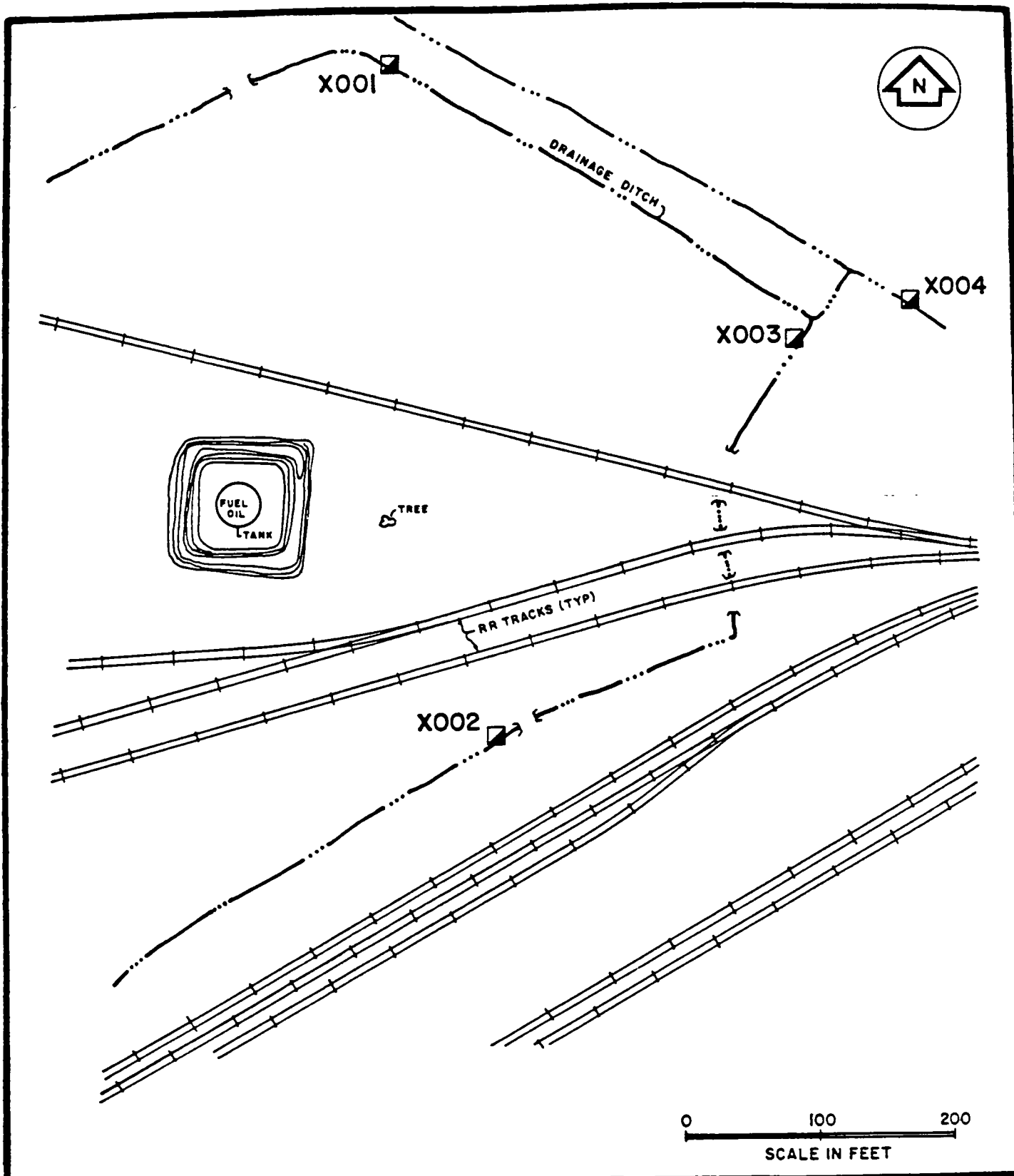


FIGURE 2-11

## SEDIMENT SAMPLE LOCATIONS

ENVIRODYNE



ENGINEERS



Sediments were collected using grab sampling techniques on September 8, 1987 by EEI personnel. A stainless steel spatula was used to collect the top three inches of sediment from three to four locations across the width of the drainage ditch. The volatile organic fraction from each site was collected and containerized initially before sampling the rest of the composite. The composite fraction from the three to four points across the ditch were placed in stainless steel pans and mixed. Dedicated stainless steel pans and spatulas were used for each of the four sample sites to prevent cross contamination. All equipment was decontaminated prior to its use on-site by 1) washing in detergent solution, 2) rinsing with tap water, 3) rinsing with deionized water, 4) rinsing with acetone, and 4) rinsing again with deionized water. Sample was placed in containers provided by the IEPA-CLP and also split with Sherex. Samples were delivered the same day to Daily Analytical in Peoria by EEI personnel. The sediment samples were analyzed for both organic and inorganic constituents as shown in Table 2-1.

### 3.0 DISCUSSION OF RESULTS

#### 3.1 INTRODUCTION

Parameters chosen for analysis in each of the site investigations included a combination of the organic and inorganic compounds previously presented in Table 2-1. These compounds were selected for analysis because they were suspected, based on background data, to be present within the Waste Disposal Area due to past disposal activities. TCE was added to the TCL after it was detected in the Waste Characterization investigation. A qualitative summary of the RI analytical results is provided in Table 3-1. This table was developed following a review of all of the soil, groundwater and sediment analytical results provided in Appendix E. As shown in Table 3-1 a number of compounds were either not detected or found at low or background levels which would indicate that these compounds were not potential site contaminants. None of the samples analyzed for pesticides or PCBs contained concentrations of these compounds above detection limits. Therefore, neither of these groups of compounds is believed to be a contamination problem within the Waste Disposal Area.

Methylene chloride and acetone were routinely detected in the samples. However, the detection of these compounds is believed to be practically unavoidable due to their use as solvents during the sampling and analysis program. Therefore, it is likely that they are artifacts rather than environmental contaminants. The semi-volatile compounds di-n-butyl phthalate, bis(2-ethylhexyl) phthalate and di-n-octyl phthalate were also detected routinely in the samples. These compounds were often found in the blank samples. Therefore, their detection was probably an artifact caused by field or laboratory procedures.

A limited number of compounds were found at concentrations higher than background levels. These compounds and the affected media included: trichloroethene, a number of semi-volatile library search compounds, cadmium and copper in the soil samples; trichloroethene, a number of semi-volatile library search compounds, cadmium, manganese and nickel in groundwater samples; and semi-volatile library search compounds in the sediments. A number of semi-volatile compounds were reported based on "library searches" performed during GC/MS runs. Each GC/MS run is governed by standards calibrated for quantifying a certain spectral range. Calibration is based on "target compounds" from USEPA Hazardous Substances List (HSL). When a chromatogram pattern matching one of the target compounds appears during a run, the compound is reported as present at a concentration calculated from the standard. When a chromatogram pattern not matching one of the target compounds appears at a concentration of greater than 10% of the standard, a "match" is attempted with non-HSL chromatogram patterns in the GC/MS computer "library". If a "match" is found, the compound is reported as "tentatively identified". Since the GC/MS run was not calibrated for these "library search compounds", their concentrations are reported as "estimated". "Tentatively identified" at an "estimated concentration" does not indicate merely "may be present at some level". It means that either the reported compounds or quite similar ones were identified as present at approximately the levels reported.

TABLE 3-1

## QUALITATIVE SUMMARY OF RI ANALYTICAL RESULTS

<u>Parameter</u>	<u>Sampling Medium</u>		
	<u>Soils</u>	<u>Groundwater</u>	<u>Sediments</u>
Pesticides	ND <sup>1</sup> /NR <sup>2</sup>	ND	NR
PCBs	ND	ND	ND
Volatiles	ND or low levels except trichloro- ethene	ND or low levels of trichloro- ethene	ND or low levels
Semi-Volatiles	ND or low levels except library compounds	ND except phthalates library search compounds	ND except library search compounds
Metals	ND or background levels except cadmium and copper	ND or background levels except cadmium, manganese and nickel	ND or back- ground levels manganese
EP Toxicity Metals	ND or low levels except cadmium	NR	ND or low levels
Other Inorganics	Background levels	ND, NR or back- ground levels	ND or back- ground levels
Notes: <sup>1</sup> ND denotes not detected <sup>2</sup> NR denotes not requested			

HSL compounds have been determined to be hazardous through standardized tests. "Library search" compounds have not necessarily been subjected to these tests and the degrees of hazard associated with them have not been established.

In order to determine the significance of those compounds found at levels above background concentrations a review of regulatory criteria was performed. The remainder of this section contains a discussion of evaluation criteria for the contaminants found, a presentation of the results of the sampling and analysis program for each medium (soil, groundwater and sediment) and an interpretation of these results in relation to the criteria.

### 3.2 EVALUATION CRITERIA FOR ANALYTICAL RESULTS

The criteria used for guidance in evaluating the Sherex analytical results included the Resource Conservation and Recovery Act (RCRA) Regulations, the Safe Drinking Water Act, the CERCLA Act and State of Illinois Standards. Each set of regulations is briefly described below.

#### 3.2.1 Resource Conservation and Recovery Act

RCRA establishes criteria by which wastes are classified as hazardous. The parameters selected for analysis in this program include eight metals and six pesticides used in the characterization of EP Toxicity. The EP Toxicity extraction test was designed to simulate the leaching of hazardous components from soil or sediments due to acid rain conditions.

The EP Toxicity test involves a combination of a solid waste with 16 times its weight of deionized (DI) water. If the pH of the resulting solution is greater than 5.0, the pH of the solution is lowered to 5.0 by addition of 0.5N acetic acid. A solid waste exhibits the characteristic of EP Toxicity if (using the test methods described in 40 CFR 261, Appendix II) the extract from a representative 100 gram sample contains any of the metals or pesticides listed in Table 3-2 at a concentration equal to or greater than the respective value given in that table. Cadmium was detected at a level above these limits in two soil samples collected during the RI.

#### 3.2.2 Evaluation Criteria Related to the Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) requires the USEPA to establish primary drinking water regulations. These regulations apply to public water systems. They specify contaminants which, in the judgment of the Administrator of the EPA, may have an adverse effect on the health of persons. They also specify for each contaminant either Maximum Contaminant Limits (MCLs) or treatment technologies. The regulations are presented in this report as criteria for comparison of analytical results with standards because it is believed that shallow groundwater aquifers could be used to provide drinking water supplies in the Mapleton area.

In accordance with SDWA, the USEPA promulgated Maximum Contaminant Level Goals or MCLGs for some of the organic chemicals and proposed MCLGs for a number of inorganic chemicals. MCLGs are defined as "non-enforceable health goals which are to be set at levels which would result in no known or anticipated adverse health effects with an adequate margin of safety." MCLGs have

TABLE 3-2

MINIMUM CONCENTRATION OF CONTAMINANTS IN LEACHATE  
FOR CHARACTERISTIC OF EP TOXICITY

<u>Metal</u>	<u>Minimum Leachate Concentration (mg/l)</u>
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0
Endrin	0.02
Lindane	0.4
Methoxychlor	10.0
Toxaphene	0.5
2,4-D	10.0
2,4,5-TP, Silvex	1.0

TABLE 3-3

FINAL MCLGs AND PROMULGATED MCLs FOR ORGANIC CHEMICALS  
AND COMPARISON WITH MAXIMUM CONCENTRATIONS  
DETECTED IN GROUNDWATER MONITOR WELLS

Compound	Final MCLG (mg/l)	Promulgated MCL (mg/l)	RI Data	
			Maximum Concentration (mg/l)	Monitor Well Designation
Benzene	zero	0.005	Not detected	All
Vinyl Chloride	zero	0.002	Not detected	All
Carbon Tetrachloride	zero	0.005	Not detected	All
1,2-Dichloroethane	zero	0.005	Not detected	All
Trichloroethene	zero	0.005	<b>0.008</b>	G104
1,1-Dichloroethene	0.007	0.007	Not detected	All
1,1,1-Trichloroethane	0.2	0.200	Not detected	All
p-Dichlorobenzene	0.075	0.075	Not detected	All

Note: All, used to denote G101 through G105.

**Bold type** denotes levels higher than proposed MCL.

no legal impact on public water systems or the public. No system is required to remove contaminants to this level or take other action regarding contaminants. MCLGs are initial goals used by the USEPA in the course of development of MCLs.

MCLs for selected inorganic and organic chemicals have been promulgated. MCLs are enforceable standards and are to be set as close to the MCLGs (health goals) as is feasible. They are based on treatment technologies, costs, and other feasibility factors such as availability of analytical methods and treatment technology, and costs for achieving various levels of removal.

MCLGs and MCLs for organic chemical parameters included in the Sherex RI are presented in Table 3-3. In this table, the maximum concentrations detected in groundwater at Sherex are compared with the MCLGs and MCLs.

### 3.2.3 Comprehensive Environmental Response Compensation and Liability Act

The purpose of the National Oil and Hazardous Substance Pollution Contingency Plan is to effectuate the response powers and responsibilities created by the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) of 1980. The National Oil and Hazardous Substance Pollution Contingency Plan establishes methods and criteria for determining the appropriate extent of response when hazardous substances are released. The states are encouraged to undertake a series of actions in case of a release of hazardous substances. These steps include discovery and notification, preliminary assessment, immediate removal, evaluation and determination of appropriate response, planned removal, remedial action, and documentation and cost recovery.

CERCLA requires that the relative potential of uncontrolled hazardous substance facilities to cause health and safety problems or ecological or environmental damage be assessed. A preliminary assessment was performed in 1984 using the Hazardous Ranking System (HRS) form which was submitted to the IEPA and reviewed during the records search.

### 3.2.6 State of Illinois Standards

The Illinois Water Pollution Regulations establish limitations related to concentrations of specific chemical constituents under its General Use Standards and Public Drinking Water Supply Standards. The applicable Illinois water quality standards for a number of metals are presented for comparison purposes in Table 3-4.

## 3.3 SOIL SAMPLING RESULTS

A total of 85 soil samples were obtained from the nine boreholes (B-1 through B-9) drilled during the RI. The nine borehole designations correspond to sample numbers X100s through X900s, respectively. Of the 85 samples, 57 were analyzed for the TCL compounds and 28 were analyzed for a more extensive list of compounds TCLs/PCLs as shown in Table 2-1.

Several volatile organic compounds were detected in the soil samples. Volatile organic compounds found at levels higher than detection limits included trichloroethene, 1,2-dichloroethane, toluene, tetrachloroethene

TABLE 3-4

COMPARISON OF MAXIMUM GROUNDWATER CONCENTRATIONS  
FOR EACH METAL WITH STANDARDS<sup>a</sup>

Parameter	RI Data		Final MCLG	Promul- gated MCL	State of Illinois General Use Standards <sup>b</sup>
	Maximum Concentration	Monitor Well Designation			
Arsenic	<10	All	50	50	1,000
Barium	110	G103	1,500	1,000	5,000
Cadmium	12	G104	5	10	50
Chromium	21	G103	120	50	50
Copper	18	G102	None	None	20
Iron	<b>1,320</b>	G101	None	None	1,000
Lead	28	G101	20	50	100
Manganese	200	G105	None	None	1,000
Mercury	<0.2	All	3	2	0.5
Nickel	252	G105	None	None	1,000
Selenium	<5.0	All	45	10	1,000
Silver	<7.0	All	None	50	5
Sodium	<b>120,000<sup>d</sup></b>	G103	None	None	20,000 <sup>c</sup>
Zinc	31	G104,G105	None	None	1,000

## NOTES:

<sup>a</sup>All concentrations in ug/l<sup>b</sup>Illinois Water Pollution Control Rules, Title 35, Subtitle C, Part 302, Subpart B - General Use Water Quality Standards, Section 302.208.<sup>c</sup>Recommended value, as per conversation with the Illinois Department of Public Health.<sup>d</sup>Numbers appearing in bold type exceed promulgated MCLs or other standards.



(tentatively identified compound) and 1,1,2-trichloro-1,2,2-trifluoroethane (a library search compound). Trichloroethene was the only volatile organic found at a level considerably higher than the detection limit of 5 ug/kg. Trichloroethene was found at a maximum concentration of 1,390 ug/kg in sample X704. Therefore, it may be indicative of on-site contamination in the vicinity of the Waste Disposal Area.

The semi-volatile library search detected a number of unidentified compounds such as unknown phthalates and unknown hydrocarbons, and unknown organic acids. The detection of these compounds may indicate the potential for soil contamination from on-site process sources. There is a possibility that the presence of phthalates could be from laboratory contaminants.

A summary of the maximum metals concentrations within each borehole are presented in Table 3-5. Cadmium, calcium, copper, magnesium, and manganese concentrations were found at elevated concentrations in a number of samples when compared to the average concentration of Borehole B-1 (assumed an upgradient sample). However the only metals which appear to be indicative of possible contamination are cadmium and copper. Cadmium and copper were detected at levels several orders of magnitude higher than the Borehole B-1 average. The highest total cadmium concentration detected in borehole sampling was 435 mg/kg at Borehole B-7 in sample X708. This sample was collected just above the shale at approximately 21 feet below the ground surface. Shallower and deeper samples obtained within this borehole showed levels at least one order of magnitude lower than the one collected at the shale interface. Likewise, copper was detected in the same borehole at a maximum concentration of 22,900 mg/kg in Sample X707 (18 to 21.2 feet below ground level). This value is also several orders of magnitude higher than the average of Borehole B-1. Elevated concentrations of copper were detected in samples from throughout the borehole. The maximum concentration was found at a slightly shallower depth than cadmium.

The only metal exhibiting the RCRA EP Toxicity characteristic was cadmium. Cadmium concentrations exceeded the 1.0 mg/l level in two samples. A concentration of 2.7 mg/l found in Borehole B-7 sample X708 (21.2 to 21.8 feet below ground) was the maximum level detected in the RI soil sampling program. EP Toxicity cadmium levels in adjacent samples within this borehole were an order of magnitude lower than the maximum of 2.7 mg/l found at the shale interface. A concentration of 1.39 mg/l was found in Borehole B-9 sample X907 (18 to 21 feet below ground surface) but the two samples obtained below this level in the shale exhibited a reduction in concentration of several orders of magnitude to about 0.015 mg/l.

The other inorganic analyses performed for soil samples (nitrate, cyanide, chloride, pH) were not found at levels which appeared indicative of site contamination by these compounds.

### 3.4 GROUNDWATER SAMPLING RESULTS

Groundwater samples were collected twice from the five wells installed during the RI. The well designations were G101 through G105. These samples were analyzed for the organic and inorganic compounds listed in Table 2-1.

TABLE 3-5

SUMMARY OF METALS RESULTS IN SOILS  
MAXIMUM BOREHOLE CONCENTRATIONS

Parameter (mg/kg)	Borehole Monitoring Point									
	B-1 Average	B-1 (X100's) (1)	B-2 (X200's)	B-3 (X300's)	B-4 (X400's)	B-5 (X500's)	B-6 (X600's)	B-7 (X700's)	B-8 (X800's)	B-9 (X900's)
Aluminum	4,200	6,800 (109)	9,400 (209)	8,000 (309)	<b>13,000</b> (409)	10,000 (509)	3,500 (608)	5,800 (710)	3,600 (810)	4,000 (909)
Antimony	<0.9 (A11)	<0.9 (A11)	<0.9 (A11)	<0.9 (A11)	<0.9 (A11)	<0.9 (A11)	<0.9 (A11)	<7.5 (704)	<0.9 (A11)	<0.9 (A11)
Arsenic	6.9	7.9 (109)	7.0 (208)	7.8 (309)	12.0 (409)	12.0 (509)	6.1 (608)	<b>16.3</b> (709)	8.7 (810)	8.6 (907)
Barium	25	40 (109)	280 (209)	130 (309)	45 (410)	180 (508)	37 (608)	<b>926</b> (710)	220 (809)	640 (908)
Beryllium	0.5	1.0 (109)	1.0 (209)	1.0 (309)	<b>1.2</b> (410)	1.0 (508)	0.68 (608)	<1.13 (704)	0.78 (810)	0.57 (908)
Cadmium	0.4	0.6 (102,104,106)	10.0 (208)	1.0 (301)	18.0 (408)	0.77 (501)	1.6 (601,606)	<b>435</b> (708)	24.0 (807)	46.0 (907)
Calcium	48,800	85,000 (107)	180,000 (207)	210,000 (307)	<b>390,000</b> (407)	35,000 (509)	57,000 (606)	13,200 (708)	80,000 (806)	230,000 (907)
Chromium	10.0	15.0 (109)	18.0 (209)	13.0 (309)	19.0 (409)	16.0 (509)	9.1 (606)	<b>20.8</b> (708)	12.0 (808)	12.0 (907)
Cobalt	4.2	6.4 (109)	11.0 (209)	8.9 (309)	13.0 (409)	9.2 (508)	9.5 (608)	<b>17.7</b> (709)	7.0 (810)	7.3 (909)
Copper	8.4	11.0 (108)	550 (208)	18.0 (301)	42.0 (408)	22.0 (502)	13.0 (601,606)	<b>22,900</b> (707)	17.0 (801)	160 (902)
Iron	13,300	18,000 (109)	26,000 (209)	27,500 (309)	33,000 (410)	30,500 (508)	22,000 (606)	<b>49,800</b> (710)	22,000 (810)	13,000 (907)
Lead	6.5	6.8 (109)	11.0 (207)	10.0 (307)	<b>66.0</b> (408)	6.4 (508)	11.0 (606)	14.8 (708)	10.0 (806)	14.0 (907)
Magnesium	32,500	<b>73,000</b> (107)	39,000 (208)	53,000 (307)	34,000 (407)	5,700 (509)	28,000 (606)	6,850 (710)	36,000 (808)	29,000 (907)
Manganese	543	810 (109)	440 (207)	500 (309)	<b>6,500</b> (410)	440 (509)	880 (606)	453 (710)	720 (809)	620 (907)
Mercury	<0.03	<0.03 (A11)	<0.03 (A11)	<0.03 (A11)	<0.03 (A11)	<0.03 (A11)	<0.03 (A11)	<0.1 (A11)	<0.03 (A11)	<0.03 (A11)
Nickel	9.8	13 (109)	22 (210)	17.0 (309)	34.0 (409)	23.0 (509)	28.0 (606)	<b>36.4</b> (710)	14.0 (808,810)	26.0 (907)
Potassium	903	2,000 (109)	1,300 (210)	1,800 (309)	2,000 (409)	1,600 (509)	1,700 (608)	1,588 (710)	870 (810)	<b>3,700</b> (907)
Selenium	<3.0	<3.0 (A11)	<3.0 (A11)	<3.0 (A11)	<3.0 (A11)	<3.0 (A11)	<1.0 (A11)	<1.75 (710)	<1.0 (A11)	<3.0 (A11)
Silver	<0.17	<0.17 (A11)	<0.17 (A11)	<0.17 (A11)	<0.17 (A11)	<0.17 (A11)	<0.17 (A11)	<0.55 (A11)	<0.17 (A11)	<0.17 (A11)
Sodium	316	580 (109)	460 (210)	320 (309)	1,300 (410)	160 (509)	200 (608)	384 (710)	150 (810)	<b>1,700</b> (908)
Thallium	8.8	13.0 (107)	11.0 (207)	<b>16.0</b> (307)	14.0 (407)	2.9 (509)	10.0 (606)	<0.51 (704)	14.0 (806)	10.0 (907)
Vanadium	10.2	13.0 (109)	16.0 (209)	19.0 (309)	15.0 (410)	13.0 (508)	11.0 (608)	<b>26.5</b> (714)	13.0 (810)	11.0 (908)
Zinc	34	41.0 (108)	48.0 (207)	45.0 (307)	51.0 (409)	35.0 (509)	50.0 (606)	<b>60.3</b> (709)	43.0 (806)	46.0 (907)

Note: 1) Interval within borehole, see Appendix E Data Summary for Specific Depth  
 2) **Bold type** denote maximum concentration detected in all samples for each parameter

Trichloroethene was the only volatile organic compound found in one of the the groundwater samples at concentrations above the detection limit. Trichloroethene was detected at G104 on November 24, 1987. Even at the low concentration of 8 ug/l, the detection of this compound in the groundwater may be indicative of potential contaminant migration from the Waste Disposal Area.

The semi-volatile library search detected a number of unknowns such as, unknown phthalates, fatty acids, etc. at low ug/l levels in all the ground water wells. The presence of these compounds in the groundwater is not believed to be a significant contamination problem but does confirm their presence in the vicinity of the Waste Disposal Area. However, the source of the detected compounds cannot be positively identified.

The majority of the metals analyzed during the RI were found at concentrations below or slightly above detection limits. Cadmium, manganese and nickel were detected at somewhat higher levels. The concentration of cadmium (0.012 mg/l) in Sample G104 collected in October, 1987 was slightly higher than the promulgated MCL for this parameter (0.01 mg/l). The cadmium concentration in Sample G104 collected in November, 1987 was 0.007 mg/l, which was just below the MCL. The manganese concentrations in G105 for the two sampling events were 0.143 mg/l and 0.20 mg/l, respectively. However, the Illinois General Use Standard of 1.0 mg/l for manganese was not exceeded. The highest concentration of nickel was detected in Well G105 with levels of 0.25 mg/l and 0.10 mg/l during the two sampling events, respectively. These values are about an order of magnitude higher than the nickel concentration found in the upgradient well G101 (<0.009 mg/l).

### 3.5 SEDIMENT SAMPLING RESULTS

Four sediment samples were collected from drainage ditches around the perimeter of the Waste Disposal Area and were designated X001 through X004. These samples were analyzed for the organic and inorganic compounds listed in Table 2-1.

The semi-volatile library search detected a number of unknown hydrocarbons, fatty acids, etc. which were also found in the soil and groundwater samples. These results may be indicative of discharges to the ditches from upstream process sources within the Sherex plant.

Concentrations of antimony, mercury, selenium and silver were below detection limits while most of the other metals were detected at levels in the same order of magnitude as those of Borehole B-1 or other sediment samples. Manganese exhibited the greatest variation between sites with a range of 260 mg/kg to 4,990 mg/kg. The concentration of 4,990 mg/kg was detected in Sample X003. Because of the limited sampling, the source of this compound is not known. In general, the ditches do not appear to be indicative of a significant metals contamination problems.

## 4.0 EXPOSURE ASSESSMENT

### 4.1 INTRODUCTION

The disposal of catalyst-containing nitric acid solution at the Sherex Chemical production facility in Mapleton, Illinois over an approximate 10 year period resulted in the release of contaminants to the soils, sediments and groundwater of the Waste Diposal Area. The release or potential release of contaminants from this site may endanger human health, welfare and the environment. This section of the report provides a summary of the environmental fate and transport of cadmium plus an exposure evaluation for the Waste Disposal Area under present conditions (no action option).

### 4.2 CONTAMINANTS FOUND AT THE SITE

Contaminants found at the area under investigation included heavy metals and organic solvents. CERCLA notification records indicated that approximately 25,000 to 35,000 gallons of a catalyst containing nitric acid cleaning solution were disposed at the site. Major constituents of the catalyst included cadmium and copper. Based on RI results cadmium and copper were selected for consideration for the exposure assessment. These contaminants were selected based on their toxic properties, presence in large quantities, or potential and actual releases to the environment.

These two metals were evaluated for hazardous and toxic characteristics (Table 4-1). The exposure assessment focused on cadmium because it had the higher hazardous and toxic characteristics. Cadmium was detected in soils on site. The highest concentrations of cadmium have been detected just above the shale interface. Some of the soil samples were determined to be EP toxic for cadmium.

### 4.3 ENVIRONMENTAL FATE AND TRANSPORT

The major factors influencing the environmental fate and transport of an inorganic element such as cadmium are the chemical form of the substance and the geology, hydrology, hydrogeology, and climatology of the area.

#### 4.3.1 Factors Affecting Migration

The chemical form of the substances influences such factors as water solubility, complexation, and ion exchange reactions with soils. The relative magnitude of free ionic and complexed cadmium is influenced by several processes which include hydrolysis, precitrenchation, complexation, ligand or ion exchange reactions, adsorption-desorption phenomena, coprecitrenchation, redox reactions, and biological accumulation or transformation. (Leckie and James, 1974; Weber and Posselt, 1974; James and Leckie, 1977; Phillips, 1977.) (Page 260.)

The geology, hydrology and hydrogeology of the site influence the transport of cadmium in the following ways:

- 1) Geological information obtained during the RI indicated that silty shale and argillaceous limestone acts to prevent vertical migration of the cadmium. Analytical results indicated that the majority of the cadmium

TABLE 4-1

## TOXICITY CHARACTERIZATION\*

	Cadmium	Copper
Waste Quantity	3	1
Acute Toxicity	1	1
Chronic Toxicity	3	1
Persistency	3	3
Flammability	2	2
Reactivity	3	2
Incompatibility	2	1
Corrosiveness	1	1
Solubility	1	1
Bioaccumulation	2	2
Physical State as Waste	Liquid	Liquid

## \*Notes:

Low - 1  
Medium - 2  
High - 3

at the site is located immediately above this bedrock. The bedrock slopes slightly to the east and south. Soil in the area is classified as Peoria loess sand silt to sand and gravel. These soils are well drained and allowed vertical migration of the cadmium as verified by analytical results.

- 2) Hydrological information indicate that surface drainage patterns at the site are predominantly southeasterly into channels which discharge into the Illinois River. Several man-made ditches adjacent to the Waste Disposal Area act as surface drainage channels for the production facilities. Analytical results indicated that low levels of cadmium were present in the drainage ditches.
- 3) Hydrogeologic information indicated that there is generally an east-by-southeast component to the groundwater flow toward the Illinois River. The hydrogeologic investigation indicated that the aquifer being investigated by the monitor well network is the same aquifer being used by commercial supply wells in the area. Horizontal gradients in the Waste Disposal Area ranged from 0.3 to 8.8 feet per day. Although the horizontal gradients in the vicinity of the Waste Disposal Area are high, only one downgradient well had concentration of cadmium approaching drinking water criteria limits. Thus, horizontal dispersion of the cadmium into drinking water supplies does not appear to be taking place. The Illinois River is likely to act as a natural barrier to contaminant migration to drinking water wells on the eastern side of the river.

Another factor affecting the environmental transport of a contaminant is the climatology of the area. For the Peoria area and vicinity precipitation is fairly well distributed throughout the year; however, April is normally the wettest month. The annual precipitation averages about 35.1 inches, and about 45 percent of total precipitation occurs from April through July. November through February are the driest months with a total of 7.2 inches of precipitation or about 21 percent. (National Climatological Data Center, 1982)

Winters are fairly cold with average winter temperatures of 26.5 degrees Fahrenheit and an average annual snowfall of 25.6 inches. The greatest monthly snowfall reported was 26.5 inches in February of 1900. The summers are fairly warm with an average daily temperature of 73.3 °F and maximum temperatures of about 85 °F occurring fairly frequently in July and August. (National Climatological Data Center, 1982)

#### 4.3.2 Environmental Fate

Cadmium is relatively unaffected by dry air but oxidizes readily in moist air with the formation of a protective coating of oxides. Cadmium resists corrosion in rural atmospheres but is attacked aggressively by the pollutant sulfur dioxide and ammonia in urban and industrial environments. (Nriagu, 1980)

Cadmium is readily oxidized by steam, and at red heat burns in air to form a brown oxide. It dissolves in most inorganic and some organic acids, nitric acid being the best of the acid solvents. Cadmium forms strong complexes with cyanides and amines. Many organometallic compounds of the element are known. (Nriagu, 1980)

Like other metals, cadmium is very persistent in the environment. Cadmium also bioaccumulates, and is biomagnified in the environment. Many studies have been performed demonstrating the accumulation of cadmium in marine and estuarine biota, and in soils, plants and animals.

#### 4.3.3 Environmental Transport

Environmental transport of cadmium is highly dependent on the chemical form of the complex. Based on the RI it is theorized that when the cadmium was initially disposed using nitric acid as a solvent the cadmium was readily transported through the soil in both the vertical and horizontal directions. Plant personnel indicated that fly ash was used to help neutralize the waste disposed in the Waste Disposal Area. The cadmium remaining probably exists as cadmium carbonate rather than cadmium sulfate. Cadmium carbonate is practically insoluble in water while cadmium sulfate is readily soluble in water.

#### 4.4 EXPOSURE EVALUATION

This section will identify potential routes of exposure, and characterize the populations exposed.

##### 4.4.1 Routes of Exposure

The potential routes of exposure are:

- 1) Consumption of fish from the Illinois River
- 2) Consumption of groundwater downgradient of the Waste Disposal Area
- 3) Inhalation of dust contaminated with cadmium that may have become airborne.
- 4) Direct contact with waters, sediments or soils adjacent to the site that have been contaminated by surface runoff or erosion processes.

##### 4.4.1.1 Fish Consumption

Consumption of contaminated fish is a potential route of exposure since cadmium bioaccumulates in fish. The Illinois EPA Division of Water Pollution Control was contacted concerning their "Fish Contaminant Monitoring Program" to obtain any available data. Fish monitoring data was obtained at the two Illinois River stations closest to the site (upstream and downstream). However no data were available on the cadmium concentrations in fish at these stations.

##### 4.4.1.2 Groundwater

Analyses showed concentrations ranging from non-detectable to 0.012 mg/l of cadmium were detected in groundwater monitor wells downgradient of the Waste Disposal Area. TCE was detected in the downgradient groundwater (Monitor Well G104) at 8 ug/l on November 24, 1987. Local supply well locations are shown on Figure 4-1. Table 4-2 gives additional information on these wells. Four of these wells (Sherex production wells numbered 2, 4, 8 and 9 labeled C-1, C-2, C-4, and C-5, respectively) are located downgradient of the Waste Disposal Area. The wells are used for commercial purposed and reportedly are not used for drinking. Distances ranged from 2500 to 3100 feet from the disposal area.

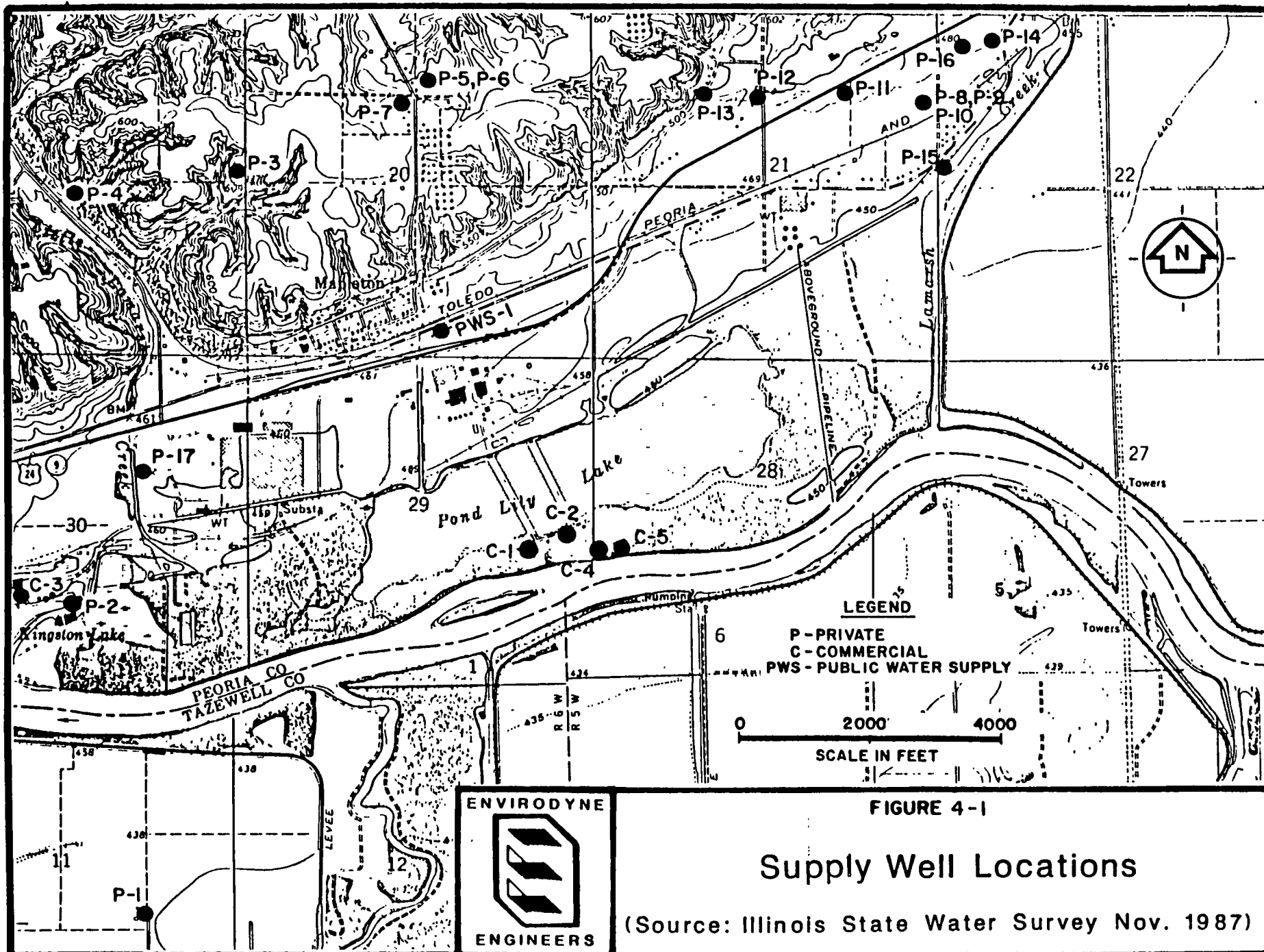




TABLE 4-2  
SUPPLY WELL INFORMATION

Designation	Date Installed	Location, Section, Township, Range	Well Depth	Water Level	Aquifer Material	Remarks
1) P-1	4-80	11, 24N, 6W	52	46	Sand	Private
2) PWS-1	1-68	20, 7N, 7E	1641	Flowing	Sand	Mapleton No. 1
4) C-1		28, 7N, 7E		-	-	Sherex #2
5) P-2	8-39	30, 7N, 7E	40	-	-	-
6) P-3	6-81	19, 7N, 7E	89	45	Shale	Private
7) P-4	6-71	19, 7N, 7E	18	6	Clay/Sand	Private
8) P-5	9-79	20, 7N, 7E	68	58	Shale	Private
9) P-6	11-80	20, 7, 7	47	33	Sandstone	Private
10) P-7	8-78	20, 7, 7	75	13	Shale	Private
11) P-8	4-80	21, 7, 7	60	30	Sand & Gravel	Private
12) P-9	4-80	21, 7, 7	60	30	Sand & Gravel	Private
13) P-10	4-80	21, 7, 7	60	30	Sand & Gravel	Private
14) P-11	4-75	21, 7, 7	11	10	Gravel	Private
15) P-12	10-78	21, 7, 7	35	24	Shale	Private
16) P-13	9-70	21, 7, 7	28	25	Sand	Private
17) P-14	4-83	22, 7, 7	48	9	Shale	Private
18) P-15	8-69	22, 7, 7	30	14	Sand	Private
19) P-16	3-68	22, 7, 7	30	12	Sand & Gravel	Private
20) C-2		28, 7, 7			-	Sherex #4
21) P-17	12-80	30, 7, 6	109	41	Sand & Gravel	Private
22) C-3	1-83	30, 7, 7	36	21	Sand & Gravel	C.F. Industries
23) C-4	8-79	28, 7, 7	65	10	Sand & Gravel	Sherex #8
24) C-5	11-84	28, 7, 7	80	11	Sand & Gravel	Sherex #9
25) PWS-3	12-33	3, 24, 5	92	34	Sand	Pekin No. 2
26) PWS-4	11-57	35, 25, 5	146	?	Sand & Gravel	Pekin No. 5
27) PWS-5	12-63	35, 25, 5	138	72	Sand & Gravel	Pekin No. 6
28) PWS-6	8-69	3, 24, 5	121	39	Sand	Pekin No. 7
29) PWS-7	10-79	23, 25, 5	131	18	Sand & Gravel	Pekin No. 8

Source - Illinois State Water Survey

#### 4.4.1.3 Airborne Dust

Another possible exposure route of cadmium is the inhalation of contaminated dust. However, analytical data indicated the majority of the cadmium present is far below the surface, adjacent to the shale layer. Surface cadmium contamination is low so this exposure route is deemed minimal.

#### 4.4.1.4 Direct Contact with Contaminated Surface Waters, Soils & Sediments

Although elevated concentrations of cadmium were detected in soils and sediments in surface drainageways, they pose a minimal health threat. Adverse health effects from dermal exposure to cadmium are minimal. Direct ingestion of cadmium laden soils/sediments would pose the greater health threat.

#### 4.4.2 Populations Exposed

This section provides an initial evaluation of the expected degree of human population contact with contaminants emanating from the Waste Disposal Area.

##### 4.4.2.1 Fish Consumption

Populations with high fish consumption from affected water bodies are at an increased risk of cadmium exposure. However, the degree of increased risk in this situation is probably minimal for the following reasons:

- While cadmium does bioaccumulate in organisms chronically exposed to high cadmium concentrations, the potentially affected water body (the Illinois River) is a large, high-flow stream and such exposure there is unlikely;
- The potential ratio of contaminants to flow volume of the receiving stream is small;
- Game fish in free-flowing sections of river systems are sufficiently mobile to minimize their exposure to any localized contaminants.

##### 4.4.2.2 Groundwater

There are four Sherex commercial supply wells downgradient of the site but they are reportedly not used for drinking water. Potentially exposed populations would be employees at the commercial facilities. Sherex employs approximately 350 people.

##### 4.4.2.3 Airborne Dust

Sherex employs approximately 350 people. Monitoring data on ambient concentrations of cadmium contaminated dust emissions from the site are not available. However, worker exposure to airborne dust is not expected to be substantial.

Areawide climatological data indicates that the prevailing wind direction for the Peoria area is southerly, so, besides Sherex employees, populations to the north of the Waste Disposal Area would have the highest potential of being exposed to airborne dust on this basis.

#### 4.4.2.4 Direct Contact

The population at greatest risk of exposure to cadmium via direct contact would be workers at the Sherex site. However, the cadmium is buried so the likelihood of direct contact is minimal. Sherex employs approximately 350 people. The Waste Disposal Area is located east of the main production facility and has minimal employee contact. Sherex plant security limits accessibility, greatly reducing accidental direct contact and exposure by the local community.

#### 4.5 TOXICITY EVALUATION

Cadmium is highly toxic to humans (Gleason et al., 1969). Acute cadmium poisoning can result from inhalation of cadmium fumes or dust, or from ingestion of heavily contaminated food or water. Severe gastrointestinal symptoms and several deaths following cadmium ingestion were reported (Gleason et al., 1969; U.S. Public Health Service, 1962; Stokinger, 1963; Browning, 1961; McKee and Wolf, 1963; Nordberg et al., 1973). The sublethal dose of ingested cadmium was estimated to be in the range of 326 mg. Acute symptoms following exposure include severe abdominal pain associated with nausea, vomiting, diarrhea, headache, and vertigo. Lethal doses, in the range of 350 mg to 9 g, further induce shock and collapse. Death may occur within 24 hours, or be delayed for 1 to 2 weeks following liver and kidney damage with attendant anuria and uremia.

In contrast to poisoning by cadmium ingestion, acute inhalatory cadmium poisoning is more widespread. The lethal dose of inhaled cadmium is estimated to be 1900 min mg/m<sup>3</sup> for cadmium oxide fumes or 10,500 min mg/m<sup>3</sup> for cadmium oxide dusts. It is to be emphasized that the lethal dose has been expressed as an air concentration/time-dependent relationship. A 10-min exposure to 190 mg/m<sup>3</sup> cadmium fumes, or less than 8 mg/m<sup>3</sup> for 4 hrs, will result in death.

The biological half-life of cadmium in man is estimated to be of the order of 10 to 40 years (Friberg et al., 1974).

The body accumulates cadmium almost entirely by intestinal and respiratory absorption. Estimates of gastrointestinal absorption range from 0.5 to 12% (Commission of the European Communities, 1974; Friberg et al., 1974), based on a limited number of balance studies. A generally accepted figure is an absorption of 6% (range, 4.7 to 7.0%) of the ingested Cd dose (Rahola et al., 1972). Absorption would be expected to vary widely, depending on the form in which cadmium is bound and on the nature of other constituents of the diet. In animals the protein content of the diet has an influence on cadmium absorption (Suzuki et al., 1969). Also, calcium-deficient diets enhance body cadmium accumulation (Larson and Piscator, 1971). Since calcium deficiencies are common among elderly persons and pregnant women, the risk of cadmium toxicity may be greater for these groups than for the general population.

Liver and kidneys accumulate relatively large amounts of cadmium and are another dietary source.

A proportionately larger fraction of cadmium is absorbed by the lungs than by the gastrointestinal system. Approximately 25 to 50% of the inhaled dose is absorbed (Friberg et al., 1974). Nonindustrial air concentrations of cadmium are so low that airborne exposure adds very little to the body burden.

Finally, it should be emphasized that alveolar absorption rates vary according to the differences in the particulate and chemical forms of airborne cadmium. As would be expected, the smaller the particle and/or the more soluble the chemical form, the greater the absorption.

After gaining entrance into the body, cadmium is sequestered in the liver and kidneys. More than half the body burden of cadmium is found in these two organs, with the larger fraction in the kidney. This organ specificity is more striking if the body burden is expressed as a concentration. The liver has 5 times more cadmium per unit weight than other parts of the body; the kidney concentration is about 50 times that of the rest of the body (Tipton and Cook, 1963). Thus it is the kidney that bears both the largest absolute amount and the highest concentration of cadmium; not unexpectedly, it is the organ of failure in high chronic cadmium exposure.

Other tissues such as the pancreas concentrate cadmium to a minor extent, but specific organ pathologies have not been correlated with cadmium concentration.

Exposure to sublethal air concentrations of cadmium may result in anosmia, dyspnea, and emphysema (Gleason et al., 1969).

There is some evidence that long-term occupational exposure to cadmium is associated with an increased incidence of cancer. The USEPA Office of Drinking Water prepared a Draft Health Advisory Report for cadmium in 1985. An excerpt of the advisory report is quoted as follows:

"A quantitative evaluation of the carcinogenicity of cadmium has not been conducted since there is no conclusive evidence that cadmium is carcinogenic following oral exposure.

Based on exposure to cadmium via inhalation, the IARC (IARC 1982) have classified cadmium and certain compounds in Group 2B: Limited evidence for carcinogenicity in humans, sufficient evidence for carcinogenicity in animals.

U.S. EPA has recommended that cadmium not be considered a suspect human carcinogen for the purpose of calculating an ambient water quality criterion (U.S. EPA, 1980).

Applying the criteria described in EPA's proposed guidelines for assessment of carcinogenic risk (U.S. EPA, 1984), cadmium, on the basis of inhalation data, may be classified in Group B1: Probable human carcinogen. This category is for agents for which there is inadequate evidence from human studies and sufficient evidence from animal studies. However, as there are inadequate data to conclude that cadmium is carcinogenic via ingestion, cadmium is dealt with here as Group D: Not classified. This category is for agents with inadequate animal evidence of carcinogenicity."

The complete advisory report is provided in Appendix F.

#### 4.6 RISK AND IMPACT EVALUATION

The most likely routes of human exposure to cadmium from the Sherex Waste Disposal Area include consumption of fish and consumption of downgradient groundwater. At this time, insufficient data exist to assess the impact of fish consumption on human health in the area. Preliminary data indicates an apparent lack of exposure potential via groundwater. However, seasonal variations and the potential transfer of the cadmium from a complexed state to a more mobile medium may dictate continued monitoring of wells adjacent to the Waste Disposal Area to verify that contamination of groundwater supplies is not taking place. Health effect problems due to inhalation and direct contact to cadmium are deemed minimal due to the present location of the majority of the cadmium.

Release of cadmium from the site may pose potential risks to aquatic and terrestrial biota because of its tendency to bioaccumulate in aquatic and terrestrial species. However, no data is available to indicate that cadmium is or has left the site.

## 5.0 CONCLUSIONS AND RECOMMENDATIONS

### 5.1 INTRODUCTION

This section of the report provides a summary of the conclusions and recommendations developed through the review of the historical data, performance of field activities, and interpretation of the hydrogeologic and analytical data obtained during the RI for the Waste Disposal Area.

### 5.2 CONCLUSIONS

The conclusions which follow were based on a review of the soil borings/samples obtained by Sherex, the soil boring/samples collected during the RI, monitor well analytical results and the geophysical surveys.

The soil samples previously obtained by Sherex indicated that cadmium contamination existed in the soil within and around the trench area. The soil samples analyzed during the RI confirmed the approximate concentration levels for both total cadmium and EP Toxicity cadmium to be in the same order of magnitude as those previously determined. No other metals exhibited EP Toxicity characteristics. The contamination boundaries along the north, east and west sides of the trench were defined. However, the southern extent has not been fully determined. One of the borings (B-9) south of the Waste Disposal Area contained EP Toxicity cadmium (1.39 mg/l) above the level which defines a waste as hazardous (1.0 mg/l). Additional boreholes would be necessary to define the southern extent of cadmium contamination. In addition, the well system did not extend to the south far enough to determine conclusively the limit of contamination. Samples from the RI Borehole B-7, centrally-located in the Waste Disposal Area, had the highest concentrations of cadmium, and EP Toxicity cadmium. Higher concentrations of cadmium were generally found just above the top of shale bedrock in the borings. Cadmium was not detected within the bedrock samples. This may indicate that the shale is acting as a downward barrier to further contaminant migration. However, the extent of fracturing within the limestone was not fully evaluated. If fracturing is present it could provide a mechanism for downward migration.

An area mapped during the electromagnetic geophysical survey of the site indicated high conductivity values. This mapped area overlapped along the western half of the area which was determined through chemical analysis to be contaminated with cadmium. Further evaluation of the Sherex boring data indicated the existence of a long trench filled in with foundry sand or fly ash. The location of this trench and the area of high EC mapped by Technos correlated very well. File information indicated that the trench used to dispose of the reactor cleaning solution also contained foundry sand or fly ash. The fact that high cadmium levels were found beyond this mapped area indicated that the EM geophysical survey was successful in defining the foundry sand trench but did not fully determine the extent of the cadmium contaminated soil.

The general groundwater flow direction was determined to be east-southeast following bedrock topographic contours toward the Illinois River. Wells were positioned around the Waste Disposal Area in an effort to monitor the poten-

tial contamination plume generated from this source. Based on this configuration and groundwater flow direction, Monitor Well G104 was determined to be the most likely interceptor of contamination resulting from this source.

Groundwater analytical results indicated that elevated levels of cadmium, manganese, and nickel were in Well G104. Concentrations of cadmium were near the drinking water MCL of 0.01 mg/l. Cadmium levels of 0.012 and 0.007 mg/l were detected during sampling rounds 1 and 2, respectively. With the exception of trichloroethene, none of the organic or other inorganic compounds analyzed during the RI were detected at levels high enough to be of concern. The concentration of trichloroethene (8 ug/l) was found at a level slightly above the drinking water MCL of 5 ug/l.

Groundwater flow rates were determined to be between 0.3 and 8.8 feet per day. This range corresponds well to the generally high pumping capacities of production wells in the area. In the a downgradient direction, there are at least four wells in potential receptor range of a contaminant plume generated from this Waste Disposal Area. These include the four commercial wells currently used by the Sherex Chemical Company. At least two of these wells (C-4 and C-5) were fairly shallow and set in sand and gravel aquifers. These wells were located several thousand feet from the Waste Disposal Area. These wells are drawing water from the same shallow aquifer as the monitor wells surrounding the Waste Disposal Area.

It is EEI's assessment that the levels of cadmium in the groundwater are not likely to increase with time, except possibly through seasonal fluctuations. It is possible the highest levels of cadmium have already been released to the groundwater over the past 10 to 15 years of the existence of the Waste Disposal Area. Several other possible scenarios include extensive dilution of the cadmium, slow release over an extended period of time, or the cadmium being tightly bound with the soil. Any of these scenarios could explain the low concentrations of cadmium in Well G104. If the aquifer were severely contaminated, these wells would have picked up the concentrations. The high groundwater flow rate and the distance to the receptor wells indicate a reduced likelihood of cadmium contamination to existing supply wells.

Sediment samples were collected at four surface drainage areas surrounding the Waste Disposal Area. Somewhat elevated levels of several metals were detected during the analyses, however the concentrations do not seem to be indicative of a significant contamination problem. None of the listed volatile or semi-volatile organic compounds were detected at elevated levels, however a number of library search unknown hydrocarbon compounds were detected in all four sediment sampling sites. These compounds appear to be similar in type to the materials used in the production areas of the plant and may be attributable to process water discharges and storm water runoff from these areas.

### 5.3 RECOMMENDATIONS

EEI recommends the installation of an additional groundwater monitoring well within the Waste Disposal Area adjacent to Borehole B-7 to provide monitoring information at the apparent "source". The monitor well network, including

this new well, should be sampled on a quarterly basis for at least one year. Analytes should include cadmium, volatile organics, and semi-volatile organics.

This will provide information on seasonal fluctuations and variations in cadmium concentration in the groundwater related to potential fluctuations. The additional well in the Waste Disposal Area will provide information on the source levels of cadmium and allow for interpretation of potential concentrations beyond the well network. In addition, the potential receptor wells (supply wells) should be monitored at least one time during this continued monitoring of the on-site well network. This will determine the extent of contamination, if detectable, in these wells. Information supplied over this extended monitoring period will help determine if remedial measures are required for the Waste Disposal Area.

The on-site surface water drainage system should be more thoroughly characterized to its end point. The Sherex ponds should also be evaluated as a potential source of groundwater contamination. This can be accomplished through additional sediment sample collection and analysis of the drainage ditches and pond water and sediments.



## REFERENCES

- Browning, E. (1961). Toxicity of Industrial Metals. Butterworths, London.
- Commission of the European Communities (1974). "Problems of the Contamination of Man and His Environment by Cadmium and Mercury." In proceedings of the International Symposium, Luxembourg, July 1973.
- Friberg, L., Piscator, M., Nordberg, G., and Kjellstrom, T. (1974). Cadmium in the Environment, 2nd ed. CRC Press, Cleveland, Ohio.
- Gleason, M.N., Gosselin, R.S., Hodge, H.C., and Smith, R.P. (1969). Clinical Toxicology of Commercial Products: Acute Poisoning (Home and Farm). Williams and Wilkins, Baltimore.
- James, A.D. and Leckie, J.O. (1977). "The Effect of Complexing Ligands on Trace Metal Adsorption at the Sediment/Water." In W.E. Krumbein, Ed., Environmental Biogeochemistry and Geomicrobiology, Vol. 3: Methods, Metals and Assessment. Ann Arbor Science Publishers, Ann Arbor, Mich., pp. 1009-1024.
- Larson, S.E. and Picator, M. (1971) "Effect of Cadmium on Skeletal Tissue in Normal and Calcium-Deficient Rats, " Isr. J. Med. Sci. 7, 495-498.
- Leckie, J.O. and James, R.O. (1974). "Control Mechanisms for Trace Metals in Natural Waters." In A.J. Rubin, Ed., Aqueous Environmental Chemistry of Metals. Ann Arbor Science Publishers, Ann Arbor, Mich., pp. 1-76.
- McKee, J.E. and Wolf, H.W. (Eds.) (1963). Water Quality Criteria, 2nd ed. Resources Agency of California, State Water Quality Control Board, pp. 148-150.
- National Climatic Data Center, "Local Climatological Data for Peoria, Illinois" (1982).
- Nordberg, G., Slorach, S., and Stenstrom, T. (1973). "Cadmium Poisoning Caused by a Cooled Soft-Drink Machine," Lakartidningen 70, 601-604.
- Phillips, D.J.H. (1977). "The Use of Biological Indicator Organisms to Monitor Trace Metal Pollution in Marine and Estuarine Environment - A Review," Environ. Pollut. 13, 281-317.
- Rahola, T., Aaran, R.K., and Miettinen, J.K. (1972). "Half-Time Studies of Mercury and Cadmium by Whole Body Counting." In Assessment of Radioactive Contamination in Man. Symposium on the Assessment of Radioactive Organ and Body Burdens, Stockholm Nov. 22-26, 1971. International Atomic Energy Agency, Vienna, pp. 553-562.
- Stokinger, H.E. (1963). "The Metals (Excluding Lead)." Chapter XXVII in F.A. Patty, Ed., Industrial Hygiene and Toxicology, Vol. II: Toxicology (B.W. Fassett and D.D. Irich, Eds.). Interscience, New York.

REFERENCES  
(Continued)

Suzuki, S., Taguchi, T., and Yokohashi, G. (1969). "Dietary Factors Influencing upon the Retention Rate of Orally Administered  $\text{CdCl}_2$  in Mice with Special Reference to Calcium and Protein Concentrations in Diet," Ind. Health 7, 155.

Tipton, I.H. and Cook, M.J. (1963). "Trace Elements in Human Tissue. II: Adult Subjects from the United States," Health Phys. 9, 103-143.

U.S. Public Health Service (1962). Public Health Service Drinking Water Standards.

File



223 WEST JACKSON BLVD., CHICAGO, ILLINOIS 60606, TEL. 312-663 9415

**International Specialists in the Environmental Sciences**

SUBJECT: Performance Event Report for TDD

RS-8212-1A      RS-8212-4A  
                     - 2A      - 5A  
                     - 3A      - 6A

The transmittal slip below has been provided for your convenience.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION V

TO: Thomas Yeates, FIT-RPO

The completed Performance Event Report(PER) for the subject TDD is attached to this memorandum.

**AWARD FEE PERFORMANCE EVENT REPORT**  
**PART I: EVENT DESCRIPTION AND OVERALL EVALUATION**

CONTRACT NO. <b>68-01-6692</b>		CONTRACTOR <b>ECOLOGY AND ENVIRONMENT</b>		TDD OR WA NO <b>RS-8212-4A</b> RS-8212-1A -2A -3A -5A -6A	
REPORTING ELEMENT <b>TORRE STOLE</b>		CONTRACTOR EVAL REPORT FILED <input type="checkbox"/> YES <input type="checkbox"/> NO		DATES OF REPORTED EVENT FROM <b>7-14-83</b> TO <b>7-21-83</b>	
PERFORMANCE EVALUATION CATEGORY <b>PRELIMINARY ASSESSMENTS</b>				NO OF HOURS	
CONTRACTOR CONTACT <b>RENE VAN SOMEREN</b>				PHONE NO. <b>663-9415</b>	
PERFORMANCE MONITOR <b>TORRE STOLE</b>				PHONE NO. <b>886-0393</b>	
DESCRIPTION OF PERFORMANCE EVENT <b>COMPLETE PRELIMINARY ASSESSMENTS FOR SITES LOCATED IN ILLINOIS, INDIANA, MICHIGAN, MINNESOTA, OHIO AND WISCONSIN.</b>					
OVERALL PERFORMANCE EVALUATION				PROJECT PLANNING _____	
				TECHNICAL COMPETENCE & INNOVATION _____	
				SCHEDULE & COST CONTROL _____	
				REPORTING _____	
				RESOURCE UTILIZATION _____	
				EFFORT _____	
* INDIVIDUAL RATINGS FROM PART II (E.G., 5-1)					
DATE		FIT- OR REM RPD SIGNATURE		OVERALL RATING	
HQ FIT- OR REM DPO'S ASSESSMENT & CERTIFICATION					
DATE		HQ FIT- OR REM DPO SIGNATURE		RATING	

LIST OF PRELIMINARY ASSESSMENTS SUBMITTED ON JULY 21, 1983

Illinois

- 1) ILD025423054 - John Deere Harvester Works, East Moline
- 2) ILD980616072 - GTE Automatic Electric, Genoa
- 3) ILD061047502 - Masonite Corp. - Roxite Fiberglass Division, Rock Falls
- 4) ILD091874320 - Chrysler Corp. - Belvidere Assembly Plant, Belvidere
- 5) ILD095792859 - Sherex Chemical Company Inc., Peoria
- 6) ILD079152518 - Borg Warner - York Automotive Div., Decatur